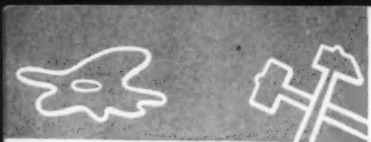

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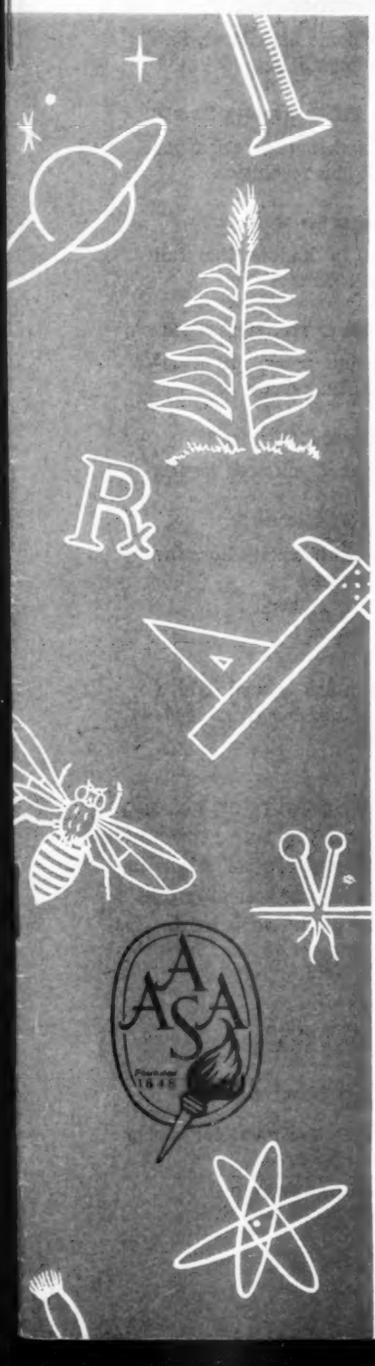

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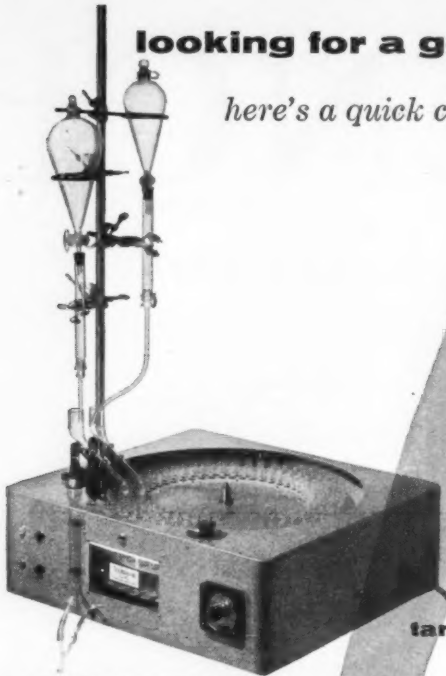

Meetings & Conferences

September

1–8. British Assoc. for the Advancement of Science, Oxford, Eng. (Burlington House, London, W.1.)

3–7. International Symposium on Infrared, Parma, Italy. (S. S. Ballard, The Rand Corp., Santa Monica, Calif.)

3–8. American Psychological Assoc., annual, New York City. (F. H. Sanford, 1333 16 St., NW, Washington 6, D.C.)

3–8. Psychometric Soc., annual, New York City. (J. B. Carroll, Harvard Univ., 13 Kirkland St., Cambridge 38, Mass.)

5–9. American Inst. of Biological Sciences, Gainesville, Fla. (F. L. Campbell, 2101 Constitution Ave., Washington, D.C.)

5–9. American Bryological Soc., Gainesville, Fla. (L. J. Gier, Dept. of Biology, Wm. Jewell College, Liberty, Mo.)

5–9. American Fern Soc., Gainesville, Fla. (W. H. Wagner, Dept. of Botany, Univ. of Michigan, Ann Arbor.)

5–9. American Soc. for Horticultural Science, Gainesville, Fla. (F. S. Howlett, Ohio Agricultural Experiment Station, Wooster.)

5–9. American Soc. of Human Genetics, Gainesville, Fla. (S. C. Reed, Univ. of Minnesota, Minneapolis 14.)

5–9. American Soc. of Ichthyologists and Herpetologists, Gainesville, Fla. (A. Grobman, Dept. of Biology, Univ. of Florida, Gainesville.)

5–9. American Soc. of Limnology and Oceanography, Gainesville, Fla. (B. H. Ketchum, Woods Hole Oceanographic Institution, Woods Hole, Mass.)

5–9. American Soc. of Naturalists, Gainesville, Fla. (W. S. Spencer, Dept. of Biology, Wooster College, Wooster, Ohio.)

5–9. American Soc. of Plant Physiologists, Gainesville, Fla. (J. F. Stanfield, Miami Univ., Oxford, Ohio.)

5–9. American Soc. of Plant Taxonomists, Gainesville, Fla. (R. C. Rollins, Gray Herbarium, Harvard Univ., Cambridge 38, Mass.)

5–9. Assoc. of Southeastern Biologists, Gainesville, Fla. (M. E. Gaulden, Biology Div., Oak Ridge National Laboratory, Oak Ridge, Tenn.)

5–9. Biometric Soc. ENAR, Gainesville, Fla. (A. M. Dutton, Box 287, Station 3, Rochester 20, N.Y.)

5–9. Botanical Soc. of America, Gainesville, Fla. (H. B. Creighton, Dept. of Botany, Wellesley College, Wellesley 81, Mass.)

5–9. Ecological Soc. of America, Gainesville, Fla. (J. F. Reed, Dept. of Botany, Univ. of Wyoming, Laramie.)

5–9. Genetics Soc. of America, Gainesville, Fla. (C. P. Oliver, Dept. of Zoology, Univ. of Illinois, Urbana.)

5–9. Mycological Soc. of America, Gainesville, Fla. (L. Shanor, Dept. of Botany, Univ. of Illinois, Urbana.)

5–9. National Assoc. of Biology Teachers, Gainesville, Fla. (J. P. Harrold, 110 E. Hines St., Midland, Mich.)

5–9. The Nature Conservancy, Gainesville, Fla. (G. B. Fell, 607 G St., SE, Washington 3, D.C.)

5–9. Phi Sigma Soc., Gainesville, Fla. (F. S. Orcutt, Dept. of Biology, Virginia Polytechnic Inst., Blacksburg.)

5–9. Sigma Delta Epsilon, Gainesville, Fla. (M. Gojdics, Barat College, Lake Forest, Ill.)

5–9. Soc. of Protozoologists, Gainesville, Fla. (N. D. Levine, College of Veterinary Medicine, Univ. of Illinois, Urbana.)

(See issue of 16 July for more comprehensive listings.)

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Mellon Institute Today

THE annual report, *Scientific Researches of Mellon Institute, 1953–54*, made by the president, Edward R. Weidlein, to the board of trustees, sets forth the investigational work and accomplishments in the institution that took place during the fiscal year ending 28 February 1954.

As an endowed nonprofit organization, the Institute seeks through adequate research in pure and applied natural science to acquire ideas and results that are of advantage to society. All the many investigational programs are for professional and industrial good and for human betterment. During the fiscal year, the expenditures for pure and applied research amounted to $4,375,712. Of this sum, $1,117,934 was spent for supporting projects in pure science on 11 fellowships and in the departments of chemical physics, physical chemistry, physical measurements, instrumentation, organic chemistry, and analytic chemistry.

In all, 131 members of the Institute were engaged in various pure science research programs. The applied science investigations were conducted by 65 other fellowships, on which 383 members have been employed. Two of the fellowships have been proceeding 40 yr; 5 are 35 yr old; 1, 30 yr; 1, 25 yr; 10, 20 yr; 19, 15 yr; and 5, 10 yr. There is a general trend to growth in the size of fellowships, and comprehensive fundamental projects are increasing more and more. The Institute's servicing staff has 208 additional workers. In the calendar year 1953 there came from departments and fellowships of the institute 12 bulletins, 55 research papers, and 56 other scientific articles. In the auditorium and conference and social rooms of the Institute meet many professional organizations of the district and also national scientific societies, allied associations, technical assemblies, and committees.

Pure research investigations have related to vibrational analysis of molecules, methods for calculating structure factors, measurement of crystallinity in elastomers, implementation of special diffraction techniques, and improvement of apparatus for thermal diffusion, distillation, and extraction. A digital computer is under construction, and a department of applied mathematics is being set up. For the *U.S. Pharmacopeia*, aromatic chemicals and surgical supplies are being studied. In microbiological researches, there has been gained a better understanding of the bacterium responsible for enhanced acid production from certain sulfuritic materials associated with bituminous coal and of the microorganisms that cause the deterioration of cellulosic textile fibers. Other pure science investigations have been concerned with air-pollution control, health of factory workers, pharmacology of potentially useful newly available chemicals, new orthopedic devices, basic physics and chemistry of the glassy state, and standardization.

Seven new applied science fellowships have been established during the year: aerosols, bituminous coal, carbon black, cleaning equipment, fatty alcohols, information processing, and Visking products. Twelve fellowships concluded their programs. Continued applied science fellowships are studying problems in watch manufacturing, fluid-flow measurements, selenium power rectifiers, organoclay complexes, structural clay products, and refractories. Dynamic properties of glass, improvement of vitreous enamels, fundamentals of abrasive grinding, and many projects in metallurgy constitute other programs. Nickel catalysts have had comprehensive investigation, and a short cut has been effected in the process for making metallic zirconium and hafnium. Wastes from the coal industry and from the manufacture of steel are securing much attention. The natural gas industry has benefited from gains in research on odorizing and underground storage. There are many important investigations in the field of petroleum: engine deposit studies, cracking research, sulfur investigations, and wax research. Advances have been made in the geriatric food program and in researches on solid adsorbents, insecticides, and corn products. A group of fellowships are investigating textile problems, embracing consumer goods, threads, industrial fabrics, and sleeping-bag fillers. Much advancement has been accomplished in synthetic organic chemistry, especially on new and improved resins and organic coatings, on silicones, and on finding and developing compounds for combating viruses and tumors.

W. A. HAMOR

Mellon Institute, Pittsburgh, Pennsylvania

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TRAVEL ARRANGEMENTS FOR THE AAAS BERKELEY MEETING

December 26-31, 1954

In time or in cost, a trip from an eastern city to California is not much more than a **round trip** to a midwestern city. Californians who for years have been attending meetings in the East have told their colleagues that the continental distance is the **same** each way, and that it should be the turn of the Easterners to visit the Pacific Coast.

The Association is planning ways it may assist those who will attend the 121st AAAS Meeting on the campus of the University of California at Berkeley, this December. The possibilities include:

1. Low cost AAAS limousines from Oakland and San Francisco airports and railroad terminals direct to the dormitory or hotel of each delegate.
2. Arrangements for traveling together in AAAS cars on fast trains leaving Chicago, Washington, D. C., and New York.
3. Arrangements for chartering first class DC6, 6B, or 7 planes of scheduled airlines—at prices comparable with air coach travel.

Note: In the following table of **round-trip** fares all figures include the new lowered 10% federal tax.

ROUND TRIPS TO OAKLAND OR SAN FRANCISCO FROM

	Chicago	Washington, D. C.	New York
By Bus	Time: 2½ days $82.50	Time: 4 days $104.94	Time: 4 days $112.31
By Rail	Time: 2½ days — leaving evening, Dec. 24 and morning, Dec. 31	Time: 3½ days — leaving evening, Dec. 23 and morning Dec. 31	Time: 3½ days — leaving evening, Dec. 23 and morning Dec. 31
Reclining seat coach	$ 99.17	$147.62	$156.64
First class	$139.10	$204.33	$222.67
Lower berth	46.20	60.06	63.58
Total	$185.30	$264.39	$286.25
By Air	Time: 7–8 hrs., leaving a.m. or p.m., Dec. 26; returning a.m. or p.m. Dec. 31	Time: 10–11 hrs., leaving a.m. or p.m., Dec. 26; returning a.m. or p.m., Dec. 31	Time: 10–11 hrs., leaving a.m. or p.m., Dec. 26; returning a.m. or p.m., Dec. 31
Air coach (no meals)	$167.20	$215.60	$217.80
Chartered 1st class (meals included)	c. $178.00	c. $235.00	c. $235.00
First class (meals included)	$239.91	$312.18	$332.09

PLEASE READ ABOVE TABLE, FILL OUT THIS COUPON, AND SEND IT TO

AAAS TRAVEL — Dr. R. L. Taylor
1515 Massachusetts Avenue, N.W.
Washington 5, D. C.

Name ....

Address ....

I shall probably attend the AAAS Meeting in Berkeley. Without obligation I am interested in possible group travel arrangements to San Francisco from:

1. ☐ Chicago ☐ Washington, D. C. ☐ New York ☐ Other city: ....
2. My preferred manner of transport is:
   ☐ Rail — coach ☐ Air — coach ☐ Bus
   ☐ Rail — 1st class ☐ Air — chartered, 1st class ☐ Other
   ☐ Air — 1st class
3. I would ☐ return east immediately after the meeting
   ☐ like to make a side trip to ....
   ☐ remain indefinitely on the Pacific Coast

Military Security in a Scientific Age

Leonard B. Loeb*

Department of Physics, University of California, Berkeley

THE term *security* is ever present in naval or military affairs. It and its antonym *military intelligence* represent functions that strongly influence the outcome of wars, campaigns, and battles. Military intelligence embraces activities leading to the acquisition of the enemy's military secrets. The maintenance of security, or security in short, represents measures to thwart enemy intelligence. The scope of military intelligence is very wide and varied, since success in total war depends on a variety of factors. The ever-increasing influence of technical developments on the fortunes of a total war, ranging as they do from industrial assets to the actual military weapons, requires a reanalysis of the question of security as understood in classical military practice.

To facilitate discussion, some differentiation and classification of the various types of data required by intelligence must be made. These data may also be assigned an approximate rating in security, indicating the degree of protection required. The use of the current security designations of Top Secret, Secret, Confidential, and Restricted are obvious and need little comment. Perhaps the term *restricted* in relation to *confidential* needs some explanation. In general, restricted information is information that is freely disseminated within say the armed forces or governmental groups, and yet is not for public dissemination, for example, in the press, where it is likely to be misconstrued and misused. It applies, in general, to material falling more in a category capable of political exploitation either by the public or by the enemy than much of the more highly classified material.

It is implied by the words *degree of protection* that high classification requires safeguards which may be more or less onerous and, thus, must lead to delays, to inefficiency, and to consequent adverse effects. Accordingly, classification must be kept at a minimum consistent with safety. This matter is not too often recognized by the responsible security officer in his specialized duties. What is generally less recognized is the continual change and the usual rapid degradation of degree of classification with lapse of time. If efficiency is to be maintained, *declassification* must be as assiduously practiced as is classification. The duration of the classification of any set of data cannot be long. Even long-range planning data should in peacetime be modified so that the original plan is no longer *the* top secret plan after some years. Most other data deteriorate in security value much more rapidly. Thus a time element is introduced into the classification groups with the reasons therefor. The classification of information begins with a division into two broad groups of objectives, primary and secondary.

Primary objectives. The primary objective implies that it exerts a direct influence on action, as contrasted with broader strategic considerations.

1) Military and naval strength as represented in personnel, equipment, and logistic support; reserves of both of these and their geographic disposition. The classification is secret and top secret. It is long range in time with regard to advance plans and short range in time during the dynamic conditions current in war and action.

2) Existing technical devices representing the present and newest weapons or devices, vehicles (planes, ships, tanks), ordnance in general, communications, intelligence, warning equipment, and so forth. These are secret or top secret, but their security value is very short-lived (1 to 2 yr and less), once hostilities start.

3) Tactical employment of vehicles, devices, and weapons; tactical doctrine, evolutions and evaluations of capabilities. These are among the most highly classified data, but the classification is relatively short-lived. It is good for 1 to 2 yr in an alert military force and it is of even shorter life once the tactics are compromised by employment in action.

4) Higher level planning on technical development, strategic theory, and policy as it involves devices primarily projected into the future. This must always be top secret. Since weapons and devices are under study and development for the future, the security will be long-lived. It is doubtful, however, whether even here a given item will remain in its classification for more than 5 yr. The first radar, for example, was maintained in its classification for some 7 or 8 yr. By this time both the British and the Germans independently had essentially the same general device, and the widespread installation, indoctrination, and consequent protection of our ships was definitely delayed by overclassification.

5) Advanced strategic, logistic, and military policy and plans for future wars and campaigns. These are obviously top secret and mostly long-range plans, but again their life should never be indefinite.

6) Communications of all types, including transportation, transmission, reception networks, intelligence, security measures, countermeasures, codes and ciphers, but not including the development of technical devices, fall in this category. Most of these are in the secret and top secret category. Practically all of them are short-lived and, as with codes, the life is very short indeed.

Secondary objectives. These data are of a more geopolitical nature. In general, much of the information is available to the enemy as well. Classification is low since, at most, the information compiled may be of convenience to the enemy. Some of it, such as meteorologic information, degrades over a few hours, some is of longer lived value. Probably the only information of a highly classified nature in this class is the extent of one's own knowledge of the enemy.

* The ideas expressed here are the author's own and in no way represent the views of the Navy or any section thereof.

1) Geographic, hydrographic, topographic, and meteorologic information on one's own and the enemy's terrains comprising the seat of possible or active conflict. Such material, in the main, is open to investigation by general intelligence procedures and, except for very few items, can well remain on the confidential level. Its security life is varied.

2) Information regarding the internal political situation of the opposing countries, public attitude, general national characteristics, loyalty, stamina, morale, susceptibility to hysteria, national health, and so forth. This information is never highly classified and is, perhaps, confidential on matters of short duration—that is, with regard to transient phases.

3) Organization of the opposing governments, chains of authority, procedures and functions bearing on possible conduct of the conflict. Being mostly common knowledge, it is generally of relatively low classification. Such information is also generally of a long-range type and will not degrade rapidly.

4) Industrial and economic potentials, logistics, communications, stockpiling, production, with emphasis on new processes, and transportation. Such information can have aspects that must be more highly classified than the others. Much of this information is of long-range classification, but in terms of 5-yr planning programs, declassification in terms of such intervals is suggested. It must be emphasized that in this country too little attention has been paid to the safeguarding of essential data on new technical and industrial developments and processes. This situation requires immediate action by those responsible for higher level planning.

National Security Policies

For the protection of the afore-mentioned security items on a national basis, there exist two general philosophies on the maintenance of security. The first is the absolute totalitarian maintenance of security involving the exclusion of other nationals and restricted intercourse of one's nationals with other peoples. This might be called the "iron curtain" policy. It was practiced in increasing measure by the German Nazi regime and, in the extreme, is being practiced during peacetime by Russia today. This policy is in some measure utilized by all countries at war. This scheme is exceedingly effective for relatively short-term periods. However, over the years it dooms its users to ultimate failure, especially in the technologic domains. Advance is possible only with the free exchange of ideas. Long confinement leads to intellectual inbreeding and lack of growth. It breeds chauvinism, overconfidence, and self-delusion. It is, furthermore, completely repugnant to free peoples.

The other philosophy is that of a planned and reasonable set of security measures within a free state. The effectiveness of this approach is influenced by several factors. It is much more difficult to develop. It is never entirely secure. It depends on constant analysis of information, classification, and declassification. It depends on patriotic cooperation of individuals and the press. It depends on constant vigilance, not only to apprehend the unreliable, but more so to condition free peoples to security mindedness. It is particularly subject to compromise by careless, inadvertent, and apparently irrelevant disclosure to intelligent and capable enemy agents who, having a clearly defined objective, can piece together information easily obtained from many individuals in a community where movement and speech are unrestricted. On the other hand, it permits healthy growth by stimulating the exchange of ideas so vital to development. It prevents the development of public delusion by practiced governmental deceit so dangerous to national welfare and to a prolonged sound popular morale. It is in keeping with democratic ideals and principles, even though in war there must be restrictions. It is also probable that the damage done by whatever leakages occur is relatively slight and probably much less than that due to the ultimate complete inefficiency of the iron curtain or to the damage done by overclassification and overlong maintenance in a classification.

The Problem Imposed on Security by Science

The United States and its future allies are committed to the second philosophy for the maintenance of security. In this regard, the United States has fought, with relative success, two major wars using classical procedures. However, the increasing dominance of science in warfare is now introducing complications that did not previously exist. The primary purpose of this article is, therefore, to discuss the problems introduced into the classical routine of security by the ever-increasing importance of science and technology in various aspects of the industrial, military, and naval establishments. It must be noted that not only military preeminence but also industrial preeminence is essential to total war, and it is increasingly clear that our past and future enemies have derived material comfort and benefit from our technical industrial advances kindly furnished them. Thus, in the future, industrial as well as military security must be regarded. With regard to security items 1, 5, and 6 in the primary group and 1, 2, 3, and 4 in the secondary group, there is not much, if any, direct influence of the technologic features, and present security doctrine can apply. Thus, discussion will focus chiefly on items 2, 3, and 4 in the primary group—that is, on existing devices and their employment, on planning and development of future devices, and on manufacturing processes of either direct or ultimate military import. In this realm, both the lack of adequate protection and the injudicious use of too-restrictive security regulations can do serious damage; in fact, to some extent Germany's scientific failures in World War II—and she made her full share—can be laid to overcompartmentation and restriction by her security measures.

To understand the problem, it must first be realized that today practically all technologic development depends on *fundamental* science—that is, on highly complicated, specialized scientific knowledge. The age of the *universal* scientist or the *general* inventor, the Rumford, the Franklin, the Alexander Bell, and the

Edison is past. Progress depends on specially trained experts and cooperative effort between highly specialized personnel. Hence, the nation most advanced by eminence in fundamental or basic science is the best endowed for ultimate success. However, science progresses only by freedom of research, by free dissemination of the ideas and results coming from such research, and by the interrelation and correlation of data, interpretations, and methods from many sources. Thus, science flourishes in an environment of free research, free discussion, free movement of personnel, free exchange of ideas, and free and rapid publication and wide dissemination of information. The background of accumulated knowledge and experience makes advance possible. Scientists are trained and steeped in the atmosphere of such freedoms. They are trained in the background, in the traditions, in the procedures, and especially in the doctrine of scientific precision of definition, skepticism, and criticism without which no sound advance can be made. Authoritarianism is repugnant to them. They speak a common language arrived at by free exchange of ideas and mutual agreement. It has taken generations to create the schools and to develop these traditions in the oncoming generations of workers. It takes continuous free intercourse to keep it going. In fact, Russia can well testify to her past stupidity in liquidating the Czarist generation of scientists and learning to her sorrow and detriment that Bolshevik professors of physics and scientists cannot be created in 2 or 5 or 10 yr from the proletariat. Even today Russian science is suffering from these mistakes, and this weakness is again manifesting itself in the appearance of a Lysenkian biology and a Leninist materialistic physics. Thus, science can flourish only in a free atmosphere, unrestricted by authoritarianism or security. Yet in war or during periods of stress, it is clear that science is closely related to vital industrial and military effort and advance, and thus there must be elements of restriction.

Such restrictions are hard to inculcate in the scientists; and patience, reasonable training, and conditioning are required to make them good security risks. That it can be done is demonstrated by the success of efforts in the last war. The scientific personnel of themselves, therefore, pose no great problem. The problem lies in the application of security to science and scientific effort itself. That this science is important to future military success is hardly doubted today. In fact, the danger in this age of the glorification of science lies primarily in the direction of overestimating its importance and, thus, in a feeling of oversecurity derived from it. In this connection, the history of wars shows that science may have been instrumental in the winning of battles, but there is no proof that it has ever *won wars*. In fact, it could be argued that the overreliance on technical devices—the submarine and the aircraft—lost Germany two wars. It is true, however, that new weapons with new tactics have been important factors in deciding battles; witness the longbow at Crécy and the cannon of Gustavus Adolphus, or the success of the *Merrimac* until she encountered a countermeasure in the *Monitor*.

Why weapons have not won wars is not difficult to explain. Wars are exceedingly complex affairs of which the separate battle is only one phase. The winning of a war depends on such things as morale, endurance, the opportunity to fight back, economic resources, and, given time, the development of countermeasures to new devices. There is no weapon—not even the atomic bomb—whose *nature* and *tactical employment* do not permit the development of suitable countermeasures, even though they may be expensive and long in developing.

However, there is no doubt that suitable devices and weapons, as well as the tactics they imply, give an immense and immediate advantage. They can thus be decisive in individual battles or actions; they can save lives and property; and they can hasten victory. Examples of such benefits can be readily drawn from the German submarines in both world wars: gas and tanks in World War I, radar in the Battle of Britain, and for the United States Navy at sea, the proximity fuse both in the Pacific and against the German buzz bombs, magnetic and acoustic mines, and last, but not least, the atomic bomb.

Thus, one must conclude that the use of such devices is imperative, that science is indispensable today for the development of such devices, and that compromises in current security practices must be developed to accommodate science. To see how this may be accomplished, certain none-too-obvious facts about the application of science to warfare must be set forth.

In order to be successful, most of the revolutionary devices, except, of course, many useful but simple gadgets, must involve the following elements: (i) long-range research and development from a scientific concept to relative performance perfection; (ii) mass production and employment; (iii) a completed, satisfactory tactical employment doctrine together with instilling confidence in the device among its users so that the doctrine is properly carried out; (iv) maintenance of security leading to the element of surprise for the enemy.

Failure to achieve one or more of these elements has often doomed a good device. Examples could be drawn in the case of the submarine and the use of gas by the Germans and of the tank by the British in World War I. To my limited knowledge, in World War II there were also several financially costly failures of American devices, owing primarily to lack of perfection and unsatisfactory doctrine, for which the lapse of time does not yet permit specific mention.

Many proposed devices are not developed, no matter how good, for various reasons. Some are developed and released prematurely. Thus, to the four criterions for a successful device, one must add the following considerations which will influence the development and planning of such devices. (i) A device must have a bearing on or use in a phase of a given *planned* campaign or objective or it must be such as to make a *new plan operative*. This restriction places different

emphasis on the developments on the opposing combatants as determined by their geographic position and objectives in strategy. (ii) The mass production and development of a major device can unbalance an overburdened wartime industrial program by allocating production priorities away from tried, proved, and vitally needed devices. This is particularly true with a really new, important, but untried weapon. (iii) The experimental production of a few such devices for test purposes in action and to develop doctrine immediately jeopardizes the security of the device and the element of surprise. (iv) Occasionally a need becomes so urgent that a device may be launched in mass production before a suitable doctrine has been developed.

To the average layman who does not understand the elements and responsibilities implied by afore-mentioned items 1, 2, 3, 4, and i, ii, iii, and iv, the condemnation of the "brass hats" for doctrinaire, unimaginative, and unprogressive thinking is easy. This common sort of prejudgment is both uninformed, unfair, and what is worse, detrimental to the war effort. Although mistakes are perhaps made in the direction of conservatism, they are not nearly as bad as those that might have been made in the other direction. For example, had the United States, during World War II, abandoned the building of the Liberty ship in favor of cargo-carrying aircraft, the result would have prolonged the war immeasurably.

First and foremost, any country engaged in total war is straining production in all directions to the limit of manpower and supplies. If the mass production of a new device is required, some other device or weapon suffers. Thus, devices that favor the objectives of the strategic planning for the war are always chosen, and other devices of merit must be put aside until needed. Germany, having no fleet, resorted to research and development of submarines in order to nullify British naval supremacy and to starve Britain. Likewise, Germany resorted to aircraft to attack Britain from the air. When the plane attacks began to fail, she turned to the development of rockets whose range permitted her to reach England without loss of precious aircraft. The United States and Britain had no need of rockets. The United States needed antiaircraft shells for the protection of the fleet against planes of the "Japanese unsinkable aircraft carriers" in the Pacific war and off the coasts of Europe, while the Germans did not seriously need antiaircraft devices until 1943. Thus, the United States developed the VT fuse.

Germany had poor submarine radar because she feared that the use of radar on submarines would disclose their position. The United States and British navies needed radar for their protection and for submarine search. The Germans developed very good infrared detectors and devices for their submarines aircraft, and troops which replaced radar, while the United States and Britain far exceeded Germany in radar perfection. The Germans developed magnetic and acoustic mines at first because they imagined that Britain was very vulnerable and they themselves were fairly immune. Later, to their sorrow, the Germans found that they needed some countermeasures, and magnetic mines did great damage when employed by the British. The United States, apprehensive because of German boastfulness concerning their atomic studies, proceeded to dislocate American war production on a huge gamble to perfect the atomic bomb before Germany. Fortunately American resources were equal to the drain; otherwise the war effort would have suffered. Germany, not having the surplus production available, and long believing herself invincible and scientifically superior, did not push atomic research.

It is believed that enough has been said to illustrate points (i) and (ii) to conclude that the decision to develop a device of major importance is a grave one, open to understanding only by those top-flight planners and their advisors who know the top secret strategic problems and who are in a position to consider the effects on production. It is probable that in the future such matters of policy decision will benefit from the type of analysis yielded by technical operational analysis groups. During World War II, in cases where the suitable scientific talent needed to formulate the necessary statistical evaluations was at hand, the decision arrived at proved to be reasonable, sound, and successful. Small-scale experimental test is in general precluded, although it was possible with the VT fuse at sea. Some of the mistakes that were made in World War II have been, perhaps, embarking on devices in desperation—that is, item (iv)—and releasing them before perfection of the instrument or doctrine and before the proper service introduction could be made. Premature and insufficient mass production was not as glaringly realized in World War II as in World War I.

In light of this review of the questions of the basic policy on the development of new devices, it is seen that once decisions in these matters are reached, planning, research, development, and introduction, as well as doctrine, must be developed in complete security.

Security in Technologic Development and Its Realization

Where does security begin and how can it be achieved? To analyze this, one lists the steps in development and perfection of the devices. They are as follows.

1) The background knowledge of fundamental science containing all the elements, some of them perhaps newly discovered, that enter into a device or weapon. Examples of this are general knowledge of nuclear structure and behavior and of the newly discovered fission leading to the bomb or again fundamental knowledge of thermionic emission and gaseous discharges as well as of optics and electromagnetic theory leading to radar.

2) A form of research that can be termed *basic research*. This is the type of research that was done, for instance, on nuclear fission with an eye to *utilizing it* for the perfection of a bomb, and the study of isotope separation needed for the diffusion and magnetic separators mentioned in the Smyth report. It also comprises the re-

searches on resonant cavities leading to the development of the klystron and the magnetron, or the researches on electron multiplication by surface bombardment in the electron multiplier so essential to television. The basic-research phase requires keen appreciation of the objective, planned scientific attack, collective or cooperative knowledge and effort, and much empirical experimenting, best entitled "gadgeteering." It involves broad practical knowledge and experience.

3) Model design and development. This aspect has two phases: the laboratory, or "breadboard," assembly of the device, and the more streamlined and completed *test model*. These phases determine whether the device, as it is crudely assembled in the laboratory, will work, and consist of making the device into a compact and more proper model for field use, with some consideration of fabrication procedures. It is followed by experimental tests.

4) The perfection of a mass-production model, its actual mass production, inspection, and the fixing of acceptance and test standards.

5) Its issue to the armed forces with tactical and technical instructions, the training of operators, and its evaluation in the field.

6) Field use and further development of the device on the basis of actual use.

As soon as the device has been used in operations, except under unusual circumstances, it must be considered compromised with regard to security in varying degrees. Thus the German magnetic mine was compromised within less than 3 wk in the field. On the other hand, the security of the proximity fuse, by virtue of its character and its use exclusively against aircraft over water, was maintained for nearly 2 yr, until after the Battle of the Bulge, when duds were picked up.

It should be noted that the maintenance of security becomes increasingly more difficult as development progresses from step 1 to step 6, and in step 6 the enemy in general may have all the details of the device except the techniques of manufacture and its technical employment, doctrine, and capabilities. Even the latter will be pretty well known by an alert enemy when the device is mass employed. The enemy can then begin to develop the same device and, what is more, to develop *countermeasures and tactics*. Whether he chooses to develop and use the device depends on his strategic problems at the time. But if the device is *good*, he will *have to develop countermeasures*. Such development can begin as soon as the device is known.

One may then ask, what is the value of security? The answer is primarily in the elements of surprise and time. An important device may require from 2 to 4 yr to perfect and mass-produce. This depends on its complexity and the effort put into it. The atomic bomb required about 4 yr; the proximity fuse required about 2½ yr. The gain, then, is in the element of surprise and in the sole unopposed employment of the device for perhaps 6 mo to 1 yr before countermeasures can be devised and perhaps 2 yr of immunity before the device can be used by the enemy in quantity—provided that the enemy was not already well advanced along the road to development. With this situation well in mind, security measures for the protection of devices must be reanalyzed. Accordingly, the foregoing data provide a basis for considering how security operates at the various steps in development.

1) First and foremost, even in war, pure fundamental research must go on, especially in a prolonged conflict. It is the basis of tomorrow's devices, and unless it goes on, the enemy will discover what one fails to discover, and he then has the advantage. In any case, the results of pure research are common knowledge until the curtain of censorship descends in war. What is known in one country by one scientist is known in another by its scientists, and *the next steps are obvious to all*. In fact, there has hardly been a great recent scientific advance or development that has not been made simultaneously at widely separated places.

The Nobel prize for wave mechanics was shared by three men. Electron diffraction was achieved simultaneously in the United States and Germany. The streamer mechanism of the spark was likewise arrived at simultaneously from different experimental approaches in two countries. Veksler in Russia and McMillan in California discovered the principle of phase stability leading to the synchrotron and frequency-modulated cyclotron independently and nearly contemporaneously. Nuclear fission was on the verge of being discovered in California within 1 or 2 mo of Hahn's discovery in Germany.

Security cannot and must not be applied to pure science. The nearest approach to an application of security restrictions to pure science occurred in 1940 when, on the verge of World War II, all American nuclear research physicists by *voluntary consent* agreed not to publish their work in current journals but to pool all information for the common large group through a common circulating agency. The group was very large and, with the Nazi military successes at their height, circumstances leading to near hysteria perhaps made this procedure pardonable. It probably would have been just as well if only the researches bearing more or less directly on military objectives had been suppressed.

One example of unnecessary restriction on such knowledge during World War II lay in the obstacles placed in the way of scientific workers on a certain project by ignorant but well-intentioned security officers in the matter of the Kerr cell optical shutter. This device, used for the visual study of events in very short time intervals, had been quite widely exploited by physicists throughout the world from about 1930 on. Before 1937 the device had been perfected in techniques, and all details, far beyond the requirements for the application to war devices in the early 1940's, had been published. This classification of the Kerr cell shutter merely hampered the work of the group by imposing cumbersome and onerous restrictions on the workers and by making the acquisition of knowledge from former experts difficult. The mistake in classification in this instance lay in attempt-

ing to classify common scientific technique and knowledge. What was really to be classified was the *fact that a certain war device was being perfected and that the Kerr cell was being used as a component part of this device.*

It is not only possible but is often urgent, to issue to public laboratory use information about devices of general application and usefulness, even if they were developed as, and were used in, a component of a highly secret device. If published out of context and with the general uses indicated, other than the secret device in question, the chance that this information will aid the enemy more than one's own scientists working on other projects is remote indeed. This is especially true with regard to the natural restrictions on the international exchange of journals in time of war. What is classified and highly classified is that a given device is being worked on and that it employs certain principles and component devices. Thus, it can be said that, in general, *science should go on, and that it should publish freely in the fundamental field,* scrupulously avoiding mention of possible applicability to military devices. Thus security has basically no concern with this phase, for the chances are that an alert enemy has discovered the same data independently.

This leads to a very important axiom and its obvious corollary. *Science is universal.* All countries have some good scientific men. If the time for a discovery or advance is ripe—that is, if one has it for one's own use—*one can be sure that the enemy also has it if he needs it.* Being secretive about fundamental science results only in deceiving oneself by a feeling of false security. It is best that all nations start from a common basis; then all know where they and their opponents are. This situation leads to a very important corollary doctrine that must always be borne in mind. *Never begin development of a new measure without simultaneously starting to work on a countermeasure.* The chances are that the enemy is as well advanced on the device as one is oneself. The enemy does not have the device only because he thinks he does not need it or is unwilling to dislocate other production for it. Such was the case of magnetic mines in Japan, a country that was preeminent in magnetic studies at the start of the war and had learned of their use from their German allies. In this case, Japan did not have the facilities for production in competition with more urgently needed devices.

To illustrate the importance of countermeasures, American scientists at one point in the war realized that a certain weapon was possible. They began *simultaneous* work on both the *device and its countermeasure.* Security-minded groups in the higher echelons, realizing the very great potency of the weapon and the difficulty in developing a suitable countermeasure, placed the device on the top secret list. Furthermore, they terminated all work on the device *and on its countermeasure* in the fear that the enemy would learn of it from us and use it. The enemy learned of the device from his own scientists at about the same time that it was thought of in the United States. On a certain crucial day in the war, the enemy launched it after all. Under these conditions, there was no countermeasure until $1\frac{1}{2}$ yr later. By this time, the countermeasure was no longer needed. Again there was the story of the magnetic mine. It was developed by Germany for use against Britain, because Germany believed that Britain was more vulnerable, since Britain had sea supremacy, while Germany had air supremacy; Germany developed no countermeasure. This was serious, since as Britain gained air supremacy, German shipping losses from the British-laid mines, with only rudimentary German degaussing, accounted for nearly one-half of her tonnage losses in restricted waters.

There is, perhaps, only one additional statement to add to the foregoing. Techniques following along the same scientific grooves must in general be parallel; note the similarity in early radar techniques developed secretly in three widely separated countries. However, differences arise owing to natural resources and manufacturing processes. Thus, for instance, Germany, having an ample number of good mechanics for a considerable period, actuated her magnetic mines by dip needles of very fine workmanship. The United States, being short on instrument makers but long on radio amateurs and techniques, activated our mines with electronic devices, which the Germans also used later. Such differences are, however, trival and aside from the main argument.

2) When basic research toward the development or proposed development of a weapon begins, security enters and on a high level. Until the results indicate a possible successful solution, the classification may not be more than secret. If, however, the development is essential to any large plan, then the highest degree of safety must be insured from the start. In such a project, the scientific group must be relatively large, since a wide range of technical knowledge may be required. This is especially true since the exchange of ideas with outside workers in these special fields is not possible. A considerable amount of work on component parts can be farmed out to sections in which the workers are ignorant of its ultimate application, thus increasing security.

3) When the working-model phase is reached, the security rating must be placed at the highest level connected with the importance of the device. The device at this stage is known to work, and some of its tactical possibilities and limitations are revealed. At this point, components are fabricated in separate locations, and assembly and tests are centralized in a relatively few, carefully selected personnel.

4) When the device goes into mass production, the security begins to be compromised. Even though production of parts is farmed out, the ultimate assembly line involves many people, and careless and idle gossip begins to leak out. This was clearly indicated in the advance information that the British had of the V-1 and V-2 weapons. They knew of the perfection of *a* device. They knew of its general character. They

knew that it would be launched from a far shore. They may have been able to guess the principle on which it worked. They did not know its exact forms. They did not know its tactical qualities or to what extent it could be mass-launched. They did not know how to produce it. They did know approximately when it could be expected. Such information might have *initiated research* for making such a device had the British seen the need for it. The knowledge they had could not aid them in *devising* direct countermeasures. It did permit them to hinder the work by bombing the *suspected* launching sites and, at an earlier time, to bomb Peenemunde where the project was being developed. Both of these pseudo-countermeasures certainly embarrassed and delayed the Germans and possibly prevented a catastrophe to Britain. It is seen here that the security leak in phases 3 and 4 on the German V weapons did lead to some sort of countermeasures and to a possible early start on development of a similar weapon had the British been so minded.

5) and (6) Real compromise comes, and in the V-bomb case came, with the issue to the field and field use. Once the bombs began to fall, even though often only pieces were recovered, the British rapidly learned how they were made, how they operated, and how they could be countered, if at all. The same applied to the homing submarine torpedo, the guided aerial torpedo, and the magnetic mine. Once the homing submarine torpedo and the guided aerial torpedo were used, they were recognized in a short time; countermeasures were readily developed and were in service within a few months. In the case of the magnetic mine, one mine was seen to have been dropped in the second week of operations. It was recovered, giving the show away to the British, and the degaussing cable was used within 6 mo or less. Thus, the only advantages remaining after field use and compromise are the advantage of several months' to a year's use without countermeasures, the advantage of sole use for 1 or 2 yr before the enemy uses the device in quantity, and the knowledge of methods of production—that is, the "technical know-how" and some details of the tactical employment and doctrine. Of these elements in surprise utilization, only the last two items remain in a classified category after field use. For the sake of efficiency then, shortly after use and capture restrictions should be removed on most of the items involved.

It is hoped that, in the foregoing analysis, the scope, significance, and value of technical and scientific contributions to the art of war and their security value has been indicated. A few more words should be added concerning this and other aspects of security in regard to science in warfare. In peacetime, the data on steps 2–5 in the development of new devices obtain. Security is easier to maintain as the tempo of production and development is less. There is no compromise by use, and the security with fewer and more carefully selected career service personnel is better. There is no chance for field evaluation against an enemy and thus no compromise. However, declassification of obsolescent material must be continual as the device changes and evolves. The use of newer devices by the services should be encouraged and extended, and the services should be indoctrinated on older models at some risk of security. Thus, as stated, the Navy radar was of little help to the fleet at the time of Pearl Harbor and shortly thereafter, although it could and should have been "sold" to the fleet by 1939. With this warning, one may leave research development.

Security in Other Applications of Science in Warfare

Science is now entering an entirely different aspect of military service in the guise of "Operational Research." In this work the scientists must have access to the most secret information. These men, chosen for their ability and their discretion, are fortunately few in number, and the top secret security is easy to maintain, because this type of activity falls into the category of the classical security rules governing all operational work.

Finally, science must again enter another field, that of true "Technical Intelligence." During World War I, any competent military or naval career officer versed in the technical branches could serve as a valuable technical intelligence officer. During World War II, the technical intelligence teams were composed of literally scores of experts in all imaginable fields of science and technology. Again, many of these men were no longer regular service officers but reserves and technical civilians. Here again there is danger of security violation by more numbers and lack of training. The danger of compromise is not primarily from loose talk, although this can occasionally happen. The danger lies in the fact that the men, being perforce experts in their field, know *too much about the details of the development of the art in their own country*. If captured, the danger of their innocently or under torture revealing much more information than could be gained from the compromise of a single weapon is great. Thus, such officers should be carefully picked on the basis of discretion and competence but so as not to have *too much dangerous knowledge*. They should be carefully guarded from capture and briefed for their own protection. On this score, read, for example, *Alsos* by S. Goudsmit, [Schuman, New York, 1947]. As we know today, even with Goudsmit's little knowledge of the details of the bomb, his capture by the Germans might have been very embarrassing. A second danger of another kind lies in the briefing of such officers. Probably the two most compromising documents that I saw during the war were *written briefing instructions* to technical intelligence officers—one for an American officer going overseas and the other from Germany to a German intelligence officer. By reading such a list, if it is captured (and the German list was captured), the enemy could, with the utmost clarity, discern the exact extent of technical advance in devices and weapons being used in the area in question of the nation writing the

brief. Such briefing should be in the *head* of the intelligence officer and nowhere else. The classification in technical intelligence reports should generally be fairly high, as should all intelligence data. It would be quite advantageous to the enemy to know the extent of one's knowledge of the enemy's devices and how seriously his weapons are compromised. Downgrading of security in such reports will, however, be rapid.

Strategic Planning in a Scientific Age

With the foundation laid by the preceding analysis, it is tempting to extend the scope of this article to draw some vital but obvious conclusions paralleling those concerning the rapid degradation in classification resulting from scientific advance.

To the extent that new weapons and devices influence the outcome of battles and wars, it is clear that the rapid advance of fundamental knowledge must directly affect the development of a nation's strategy and tactics. Thus, to be best prepared, strategic planning, weapons development, fabrication, and stockpiling must keep pace with scientific advance.

It is interesting to note that great strides were made in fundamental research during the years immediately following the last two world conflicts and also during the years between the conflicts. In contrast to this, little fundamental advance occurred during the war years, but enormous technical and industrial advances took place based on the previous fundamental research developments, leaving the residue of useful fundamental scientific knowledge very meager. That is to say, under the stress and exigencies of war, the whole of a nation's manpower and all resources are poured into the exploitation of the fundamental findings of the past to practical and useful applications. Such expenditures are justified by the emergency but would ruin national economy in peacetime. With the expenditure of a nation's best scientific manpower and wealth in the vast coordinated efforts required for influence, mines, proximity fuses, radar, atomic bombs, and so forth, the basic research potential is exploited to its limit, and as noted, at times fabulous practical results may be derived.

In the immediate postwar years, all manner of new devices, mass-produced and accessible at reasonable cost for the subsequent fundamental research work, are at hand for the research scientist. Thus, for example, World War I gave the world the continuous wave oscillator tubes so essential to basic research, as well as reasonable advances in chemical technology. World War II left the physicist inexpensive, fast sweep oscilloscopes, microwave techniques, photomultiplier tubes, many magnetic and acoustic devices and techniques, to say nothing of the nuclear reactor piles and the remarkable wealth of tracer isotopes they yield.

With this pattern in mind, it must next be realized that it is only during a war that weapons development can be prosecuted, politically and economically, to greatest advantage and also it is only during a given conflict that strategic and tactical problems are sufficiently clearly defined to enable *efficient* weapons and devices development. It is only when the aggressor moves and discloses his strategy, weapons, and tactics that the planning to defeat him can properly be undertaken. Doubtless under these conditions the aggressor enjoys an initial advantage, but such advantage of initiative is in all ways on the side of the aggressor who can choose time, place, and means. When the conflict begins, then and only then, can the nonaggressor nation that is richer in scientific potential go into effective action against an adversary who has *frozen* his weapons into production some years before he attacks. Thus the aggressor's weapons are on the obsolescent side once he initiates action, while the nonaggressor can go into production on newer type weapons.

Thus, consequent to the rapid accumulation of fundamental scientific knowledge and techniques in times of peace, great care must be used in deciding to go into the development and production of weapons and a strategy built about them, which may, in the next 5 yr, become obsolete.

Much disappointment and criticism was manifested when the United States entered the Korean conflict and no stockpiles of the promised adequate, new weapons were at hand. Apparently satisfactory aircraft were in production at that time; otherwise, *quite properly,* within 5 yr of World War II, the United States had not gone into production of the half-developed weapons of the future. What actually was lacking in that emergency were the adequate quantities of World War II weapons that had been generously abandoned to the enemy in the former world-wide bases on evacuation. The American scientists, military planners, and manufacturers were not to blame for this situation. The fault, if any, must be laid squarely at the door of the American people who were much more interested in demobilization, disarmament, and economy, over the protests of the administration and Defense Department, than they were in preparing for emergency. It is also possible that too much loose talk by scientists of "push-button" techniques just around the corner may have contributed to this situation.

Perhaps the most striking and tragic mistake in long-range planning in recent history was the development of the Maginot Line. Fresh from the lessons of World War I, France, financially impoverished, built at enormous cost, what, by standards of the immediate postwar period, was to be the impregnable barrier that no enemy could break through—the Maginot Line. The Maginot Line was not even completed when France discovered to her sorrow that it was obsolete and that her security was gone. Less than 8 yr before World War II broke out, a weapon, considered to be a failure as the result of inadequate tests during World War I proved, under General Guderian, to be the device around which the whole strategy of the armored column and mobile warfare was developed. Once this new tactical device and its accompanying air arm were ready, after a year of the "phony war,"

the new strategy of mobile columns was launched sweeping around and through the obsolete Maginot Line.

It should give this country serious food for thought, with its need for economy and a defensive philosophy during these times of troubled peace, lest it in turn build an excessively costly "Maginot Line" that will be obsolete before it is finished and will so dislocate the economy that more suitable weapons will be lacking. It must further be held in mind that once such a defensive line is begun, the future aggressor will, like Hitler, bend his strategic efforts toward circumventing that line.

Although no specific solution to today's problems of defense can be given, the foregoing considerations might indicate certain reasonable procedures that will be conducive to ultimate victory if conflict is inevitable. These are

1) An intensive support and pursuit of fundamental science so that this nation will remain in the forefront and its stockpile of knowledge will be ahead of all other nations.

2) The training of adequate scientists and engineers so that when the emergency arrives the manpower needed for the development of weapons will be adequate.

3) A reasonable and well-chosen intensive program of basic research keeping up with the exploitation of important advances in fundamental science. Such effort must in considerable measure be monitored on the basis of top-level strategic planning as laid down by competent military authority with the advice of operational research analysts. For the rest, it should follow the free dictates of creative imagination in industry and in the engineering schools of the country. Perhaps in this connection, judging from the published accounts of achievements, the example of the present administration of the Atomic Energy Commission may be cited.

4) An adequate development and stockpiling of the most recent versions of the standard proved weapons and devices with which to equip the forces adequate to immediate defense needs and such additional supplies as would be needed by the reserves in an emergency. It must be clear from the Korean conflict that infantry, machine guns, artllery, tanks, aircraft, mine sweepers, destroyers, aircraft carriers, and so forth, now and in the foreseeable future, will figure largely in any conflict. In addition to development and stockpiling, there must be continued experimentation and improvement of such weapons and others with an eye to emergency production at certain stages of development if sudden conflict make this desirable.

5) A constant study of possible aggressor strategy and tactics in terms of the devices that he might use, together with intensive study and consideration of countermeasures, and their development and production insofar as it is safe to freeze them.

6) Adequate stockpiling of strategic materials.

7) Adequate planning for the conversion of industry from peacetime activities to war production of the newest weapons.

With a corner on the best in scientific personnel and data, with adequate quantities of good conventional weapons, with adequate countermeasures to expected enemy tactics, with an adequate defense establishment in numbers and training of regulars and reserves on the part of a nonaggressor, if an enemy still has the temerity to launch a war, his initial successes will not be devastating, and in the ensuing prolonged struggle the nonaggressor's chances of ultimate success are good. This was eloquently proved in World War II when the American devices put in production from 1944 on showed what science could do. The initial military reverses that faced the United States in 1942 through 1943 came from a serious lack of adequate forces equipped with suitable quantities of conventional weapons resulting from a popular false sense of economy during a period of depression.

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Young men, have confidence in those powerful and safe methods, of which we do not yet know all the secrets. And, whatever your career may be, do not let yourselves become tainted by a deprecating and barren skepticism, do not let yourselves be discouraged by the sadness of certain hours which pass over nations. Live in the serene peace of laboratories and libraries. Say to yourselves first, "What have I done for my instruction?" and as you gradually advance, "What have I done for my country?" until the time comes when you may have the immense happiness of thinking that you have contributed in some way to the progress and to the good of humanity. But whether our efforts are, or not, favored by life, let us be able to say, when we come near the great goal, "I have done what I could."—Louis Pasteur.

Animal Species That Feed Mankind: The Role of Nutrition

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IN considering the species that feed mankind, it is important to understand how improved feeding practices for animals can contribute to the better nutrition of our increasing population. Insofar as animals consume food that might be eaten by man or products obtained from land that could be used to produce food for man, there is a great waste of food resources as measured in calories.

About 20 percent of the gross energy (calories) fed to a pig, the most efficient converter among farm animals, is returned in edible products for man's use. The dairy cow is three-quarters as efficient as the pig on this basis, but other animals rank much lower. For steers and lambs, the conversion figure is only about 4 percent. These facts explain why an animal industry tends to become smaller as the struggle to get enough food to fill the stomach, whatever the kind, becomes greater. As this happens, the diet becomes poorer in nutritional quality, and malnutrition increases accordingly. This is because the dietary value of animal products lies primarily in the high-quality protein, minerals, and vitamins supplied and not in their calory contribution.

Recent research, especially that dealing with the discovery of new vitamins, has served to emphasize the importance of the nutrients for which animal products are rich sources. As a supplement to the cereal diets that comprise 70 percent or more of the total food of the majority of the world's population, animal products have a special importance in supplying nutrients that are otherwise likely to be deficient, even though calory intake is adequate.

The production of animal products for man's use thus has a large significance in terms of his nutrition and health. Where population presses on the food supply, the goal of animal feeding must be to provide maximum production of the nutrients that man especially needs to supplement a cereal diet, with a minimum waste of the potential food resources as measured in calories. Animal species differ in efficiency in this respect.

Some years ago I made a study of published experimental data to determine how various species differ in the efficiency of production of nutrients per gross calory of feed consumed (*1*). In the preparation of the present paper (*2*), the results were checked with more recent data. The following generalizations seem justified.

Pigs, dairy cows, laying hens, and broilers are much more efficient in protein production than are steers or lambs. The dairy cow produces 10 times as much calcium as does its nearest competitor, the hen, and also ranks ahead of all others in riboflavin production. The hen ranks first in vitamin-A production, followed by the dairy cow, while the other species do not produce significant amounts. The pig ranks first in thiamine, the broiler in niacin.

The steer and lamb show a low efficiency in the production of all nutrients on a gross energy-intake basis. The primary reason for this is that their rations are of much lower digestibility because of the large amounts of roughage consumed. This is food that man cannot eat, and thus figures based on gross energy without regard to source markedly overstate the waste by ruminants of man's food supply.

This fact is illustrated in Table 1, containing data from Jennings (*3*). This table shows the number of "feed units" required by the various species to produce man's daily calory requirement. The "feed unit" used here was chosen to represent the common denominator of all kinds of feed and to equal the feed value of 1 lb of average corn. The "All feed" column reveals the same order of efficiency calculated for the conversion of gross calories of feed and the edible calories of production. Our interest lies in the "Concentrates" column, however, which shows the requirements for concentrates that otherwise could be used directly by man. On this basis, the dairy cow, which requires only one-quarter of its total feed as concentrates, is much more efficient than the pig, which excels on an "all feed" basis. The lamb, which is the least efficient on the latter basis, also goes ahead of the pig when concentrates only are considered. The beef animal also makes a relatively much better showing when concentrates alone are considered, whereas poultry depends almost entirely on concentrates and, therefore, is the least efficient.

This comparison is faulty, of course, when the

Table 1. "Feed units" required to produce 2600 kcal of human food.

Animal product	All feed (lb)	Concentrates (lb)
Pork	7.7	7.2
Milk (dairy cows)	9.3	2.3
Eggs	21.9	20.6
Poultry meat	29.9	27.1
Beef	71.6	15.2
Lamb	74.5	4.7

coarse fodder comes from land that otherwise might grow food for direct human consumption. This is true in the United States. However, ruminants do consume large amounts of straw and other by-products of human food production and also grass from land which, because of its scanty rainfall or topography, cannot be effectively cropped. Thus, cows and sheep can produce high quality human food from some areas where otherwise no food at all would be obtained. Pigs and poultry compete directly with man for most of their food supply. Where only a few per farm are kept, however, and they consume products otherwise wasted, such as cull fruits, vegetables and seeds, kitchen wastes, and worms and insects, little competition with man's food results.

There are other factors, such as maintenance of soil fertility, production of nonfood products, and production per unit of land labor, that govern the efficiency of animals as contributors to man's food supply. The purpose of this brief discussion is to show the major factors that must be taken into account in considering, on an economic and nutritional basis, how animals can contribute to man's food supply and in deciding which species can make the greatest contribution in a given situation.

All species are more efficient today than they were a decade or more ago, because of the application of the findings of nutrition research. With respect to hogs and poultry, the recognition that protein nutrition depends on the kinds and amounts of the amino acids supplied and studies of amino acid requirements and their distribution in feeds have resulted in feeding practices that result in greater production at lower feed costs. While some 22 amino acids are required to build body protein, only 10 are essential as such to nonruminants. The others can be manufactured in the body, provided that a nonspecific source of nitrogen, such as amides or ammonium salts, which can furnish amino groups, is available. This recent discovery may prove to be of great practical importance in lessening the need for protein as such. The specific knowledge that has developed regarding amino acid requirements and content in feeds also provides the opportunity for effectively using specific key amino acids which the chemical industry may produce inexpensively for the purpose. The discovery of vitamin B_{12} as a growth factor for pigs and chickens has resulted in the replacement of animal protein feeds by vegetable protein sources plus B_{12} and a more economic use of feed accordingly.

The latest development in the feeding of pigs and chickens has resulted from the finding that antibiotics in small amounts are growth factors for these species. Antibiotics are drugs, not feeds. They do not supply nutrients, but in some way they promote feed consumption and intestinal conditions that result in a marked improvement in growth, particularly in the early weeks. They bring animals to market weight more quickly and with less total feed. The improvement in growth rate to market is of the order of 5 to 20 percent, depending on the species and on various conditions, with a saving of some 2 to 10 percent of feed. Sources of antibiotics for this purpose are readily available at low cost and are in wide use. Here it should be pointed out that their principal value is in stimulating early growth. They have no demonstrated value for reproduction or for milk or egg production.

As an example of what these developments have meant in the case of poultry, the data in Table 2 are cited. The data for 1932 are taken from a study by Heuser and Andrews (*4*), and those for 1951, from Potter and Ringrose (*5*). Being experiment station data, they reflect a better-than-average commercial performance for both periods, but they do present a fair picture for comparative purposes. These data show that today chicks can reach a 60-percent greater weight at 12 wk than they did 20 yr ago, with 27 percent less feed per pound gain. The birds that required 12 wk to attain a weight of 2.5 lb in 1932 can now reach this weight in 9 wk. In 1932, 16 wk were required to bring a broiler to a market weight of 3.5 lb. Today this is being done in 10 to 11 wk, at a large saving in feed costs. Obviously there are also important savings in labor and more efficient use of equipment.

The breeds used in these two studies were not strictly comparable, but in both cases they were the heavy breeds used in commercial broiler production. Clearly, improvements in breeding and in management, as well as in nutrition, have played a role in the advances shown in Table 2. In citing these recent accomplishments, it should also be pointed out that current research gives high promise of further advances to come. A very promising field deals with the role of microorganisms in the intestine and their influence on nutrition and health, particularly as related to the nature of the diet. There is also clear evidence that some vitamins of practical importance remain to be identified.

With respect to cattle and sheep, studies of rumen functions have resulted in marked advances in improving the efficiency of feed utilization. The rumen is a big fermentation vat in which microorganisms break down the cellulose and other higher carbohydrates to metabolically useful compounds; this process enables cattle and sheep to depend to a large extent on roughage for their food. A better understanding of the biochemical and microbiological factors is resulting in

Table 2. Growth rate and feed conversion figures for chickens, 1932 vs. 1951.

Weeks	Body weight (lb)		Feed conversion (lb feed/lb weight)	
	1932	1951	1932	1951
2	0.18	0.37	1.61	1.26
4	.44	.91	2.22	1.81
6	.89	1.51	2.56	2.24
8	1.42	2.35	2.91	2.43
10	1.84	3.26	3.52	2.67
12	2.47	3.99	3.73	2.95

feeding practices that make greater use of forage and thereby lead to more economical production than has heretofore been possible.

In the rumen, bacteria also synthesize amino acids to a degree that makes the protein nutrition of the animal independent of the amino acid makeup of the feed. Amides, such as urea, and ammonium salts can be used for this purpose, thus providing building stones for all the amino acids required by the body; this is in contrast to the needs of nonruminants, whose feed must contain some 10 amino acids. Experiments have shown that sheep can build body protein with urea as the sole source of nitrogen. Urea can replace a part of the protein in the feed of ruminants without loss of production; during World War II it was widely used for this purpose. Research now in progress may be expected to show us how to make more extensive and more effective use of nonprotein-nitrogen compounds manufactured by the chemical industry. In this way, a large contribution can be made to man's food supply by freeing for his own use protein sources now consumed by ruminants.

It is recognized that both the efficiency and the extent of carbohydrate breakdown and of protein synthesis in the rumen depend on various factors that govern the microbiological flora and their activity. Bacteria require many growth factors, some undoubtedly as yet undiscovered. The study of the nutrition of bacteria, particularly in connection with rumen activity, is thus a very important field in the interest of man's food. This is the area of research on which biochemists, microbiologists, and nutrition scientists are now concentrating, to produce findings leading to more efficient milk and meat production. This field of research has practical value for the better nutrition of peoples in areas where the possibility of any significant animal industry is not justifiable unless it utilizes plant products that man cannot digest or grazing land that cannot be cropped, and also does not compete with man for protein.

A development of special significance with respect to grazing animals is the recognition of their need for trace elements which are frequently lacking in the soil and thus in the forage grown thereon. A daily intake of the amount of cobalt which could be held on the head of a pin makes the difference between life and death in a sheep. A correspondingly small amount is essential for cattle. Before this fact was known, many thousands of grazing animals died annually throughout the world, and areas were abandoned because they would not support an animal industry. Today the needed cobalt is supplied, and animal production has been greatly stepped up accordingly. The story is similar for copper. Further advances can confidently be expected from trace-element studies, in identifying additional areas deficient in those elements known to be important and in discovering other elements that may be necessary for grazing animals.

For various reasons, it is not possible to appraise quantitatively the effects of improved feeding practices for sheep and cattle as clearly as can be done for poultry and hogs, but there are data to show that important advances have been made. For example, the records of Dairy Herd Improvement Associations in New York State indicate that average yields were more than 20 percent higher in 1951 than in 1935 and were obtained with 7 percent less feed per unit of milk produced. Here again, better breeding and management have played a role.

The preceding discussion of the special nutritive values of animal products naturally raises the question of whether these values are affected by the nature of the ration, and of the possibilities of improving the nutritional quality, as well as the yields, of these products through better feeding practices. The idea has been promoted by some popular writers and others that feeds from poor soils, whether forage or concentrates, result in the production of milk, meat, and eggs of poor nutritional quality. In general, this is not true. Feeds that are inadequate in amount or quality affect the yield, and not the quality, of the product. There are some exceptions to this general statement, notably the vitamin-A value of eggs and milk, but from the standpoint of my general topic it should be emphasized that the contributions of better animal feeding practices to man's nutrition lie primarily in increasing yields of the products. It is not to be expected that marked improvement can be made in their high nutritive value. This can be counted upon, whatever the feeding system.

In the first part of this paper I discussed the problem of providing the animal products needed for the nutrition of our increasing population in view of the competition involved for basic food resources. I have in turn discussed how this problem is being met by research developments that are greatly increasing the feed efficiency of animal production and enabling animals to draw more and more on feed resources not suitable for man's direct use. It seems probable that the developments to date may represent only a beginning in the advances that may be expected in the feeding of animals, in turn to feed mankind. Meanwhile, there is a large opportunity for a much more widespread application of the discoveries already made.

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News and Notes

Dental Medicine

The American Academy of Dental Medicine held its 8th annual meeting, 14–16 May, when the Philadelphia section acted as host to an international gathering of more than 300 dentists and physicians. The scientific portion of the meeting consisted of symposiums and discussion groups and featured the latest developments in the diagnosis and treatment planning of oral diseases and the systemic conditions often related to them. Several business meetings were held, and George F. Clarke of Boston was installed as president for 1954–55. Others elected to serve with him were pres.-elect, S. Leonard Rosenthal, Philadelphia; v. pres., William H. Copperthwaite, Red Bank, N.J.; sec., William M. Greenhut, New York; and treas., George Stewart, Philadelphia. Irving Yudkoff of New York is editor of the Academy's *Journal of Dental Medicine.*

Anthony Sindoni, Jr., medical director of St. Agnes Hospital and chief of Metabolic Service at the Philadelphia General Hospital, stated that medical achievements had helped reduce the mortality rate in diabetes in this country from 17.2 percent per 1000 population in 1900 to 9.7 percent in 1949. He said that both increased cooperation between physicians and dentists in recent years and the expansion of research have resulted in improved care for the patient. Dr. Sindoni also pointed out that the dentist's better understanding of the signs and symptoms of diabetes would enable him to help discover some of the 2 million or more unknown diabetics throughout the nation when he examines their mouths during dental treatment.

Norman G. Schneeberg, chief of the endocrine clinic at the Albert Einstein Medical Center, spoke on diseases of the important glands of the body that sometimes result in darkening of the skin as in suntanning. He stated that any marked changes from normal pink mouth tissue—especially newly developing spots on the lips, gums, or tongue—were clues to the same types of glandular disease.

The diagnosis of allergies having symptoms that are reflected in the mouth was discussed by M. Harris Samitz of the University of Pennsylvania. He said many allergies are caused not by food but by such unsuspected offenders as toothpastes, mouthwashes, and lipsticks. Dr. Samitz also stated that ultraviolet light is proving helpful in distinguishing leukoplakia, a potentially dangerous mouth condition, from a harmless one called lichen planius that closely resembles it. Occasionally it becomes almost impossible to differentiate between the two diseases. The ultraviolet light, with a special filter attached, is flashed in the patient's mouth. If the condition is precancerous, it will shine with a white fluorescence; if it is not, the light will not pick it up. The speaker described the mouth as a window through which many ailments in other areas of the body can be seen and also as a mirror that reflects the general health of the patient. Ulcerative colitis, for instance, occasionally is accompanied by lesions of the mouth. Dr. Samitz reported a study of 189 persons who suffered from ulcerative colitis. A third of the patients had some sort of skin manifestations, many of them in the mouth. Research is going on to ascertain the connection between colitis and mouth sores.

In a symposium on the dental phases of diagnosis and treatment planning, Jack Balin of South Norwalk, Conn., emphasized the importance of proper equilibration of dental occlusion; Samuel Charles Miller, professor of periodontia at New York University College of Dentistry, discussed the early recognition of periodontal disease and its control and cure through early and properly planned treatment. Endodontics, the treatment of pulp canals, was outlined by Samuel Seltzer of the University of Pennsylvania School of Dentistry; and the successful rehabilitation of the mouth through dental prosthetics was presented by Morton Amsterdam of Temple University School of Dentistry.

Dean Gerald Timmons of Temple University School of Dentistry and Dean Lester W. Burket of the Thomas W. Evans Museum and Dental Institute, both of Philadelphia, were elected to honorary membership in the Academy, and at a dinner on 16 May suitable awards were presented to them in recognition of their outstanding contributions to the field of dental medicine. Academy fellowships were given to Albert LaFerriere of Canada, Harry Roth of New York, and S. Leonard Rosenthal of Philadelphia.

William M. Greenhut, *Secretary*
American Academy of Dental Medicine

Science News

Army authorities have announced that Bernard Martin, a technical writer suspended a year ago from Fort Monmouth as a purported security risk, was notified on 9 July that he could return to work at the electronics center. The Army did not disclose whether Mr. Martin, who was informed of the charges against him in Sept. 1953, would be put back on his old job. Mr. Martin reportedly was one of 21 Fort Monmouth employes suspended from their jobs as alleged security risks and given hearings by the First Army Review Board. Thus, he would be the first of the group cleared publicly.

Fritz London, professor of chemical physics at Duke University since 1939, died on 30 Mar. at the age of 54. In the July issue of *Physics Today* one of his colleagues writes that he "was a man dedicated to his work . . . the embodiment of the pure scholar . . . forever probing new ideas and perfecting old ones. . . . His were the highest standards of intellectual integrity . . . a man of culture with wide interests. . . ."

Dr. London was educated at Munich, Goettingen,

and Paris, and was engaged in research in Europe before he went to Duke. While at Zurich he wrote, with Heitler, the famous paper that gave the quantum mechanical explanation of the homopolar bond. Later he concerned himself with the dynamics of atomic and molecular interactions. In 1953 he was awarded the Lorentz Medal of the Netherlands Royal Academy of Science. This year he was honored at Duke with a James B. Duke distinguished professorship.

In the August issue of ***The Scientific Monthly***, D. E. Ferguson of the Oak Ridge National Laboratory discusses the economics of chemical processing for a breeder-type reactor intended primarily for power production. The purpose of chemical processing is to enable the reactor to produce power as economically as possible by removing the fission products—the nuclear "ashes" which lower the efficiency of reactor operation—and by reclaiming unspent fuel and source material. The costs that vary with the frequency of processing may be optimized, and the cost of processing per unit of electric energy produced may be expressed in terms of such variables as the value of fissionable material as fuel, the unit cost of chemical processing, and the fraction of material lost during processing. The author has evaluated the effect of these variables on the cost of nuclear energy.

According to a recent release from the Polish Embassy, 22 new research centers will be established by the **Polish Academy of Sciences** this year. Their activities will cover a wide range of problems in biology, mathematics, the physical and social sciences, and technology. By the close of 1954 research centers functioning under the Academy's auspices will total 67 as against 6 in 1952.

The Canadian Dominion Bureau of Statistics reported on 3 June, in its first breakdown of population estimates by marital status, age, and sex, that only one out of every four females and one out of every three males of 15 yr and over were single in 1952 as compared with one out of every three women and two out of every five men a decade earlier. In the 10-yr period the **number of married Canadians** increased by one-third.

A light-weight **respirator** weighing only 23 lb has been developed by the Swedish Gasaccumulator Co., Stockholm. The apparatus, called the Pulmospirator, is powered by a mixture of compressed oxygen and air. A pulsating valve controls admission of the oxygen-air mixture in the inspiratory phase, and exhalation is through a side tube. A feature which might not find enthusiastic acceptance is that the method involves use of a tracheotomy incision for administration of the oxygen-air mixture.

A new kind of **package that prevents spoilage** of living tissue-culture cells and other temperature-sensitive materials during shipment has been developed by Maria Telkes, Hyman Steinberg, and other members of the research division of New York University's College of Engineering. Key feature of the thermally insulated container is a can filled with a compound such as Glauber's salt that emits or absorbs heat upon freezing or melting, thus keeping the temperature inside the package within a range that can be adjusted by changing the compound. The National Foundation for Infantile Paralysis, which made the grant for the development, will use the new package in its nationwide evaluation study of the effectiveness of the Salk vaccine for poliomyelitis.

A **nova** was discovered in the constellation of Scorpio the night of 4–5 July by Guillermo Haro and Lauro Herrara of the Observatorio Astrofisico Nacional, Tonanzintla, Puebla, Mexico, an area in which Scorpio is nearly overhead. The nova's position, based on the 1875 equinox, was reported as 17 hr, 50 min in right ascension, −36 deg, 15 sec in declination.

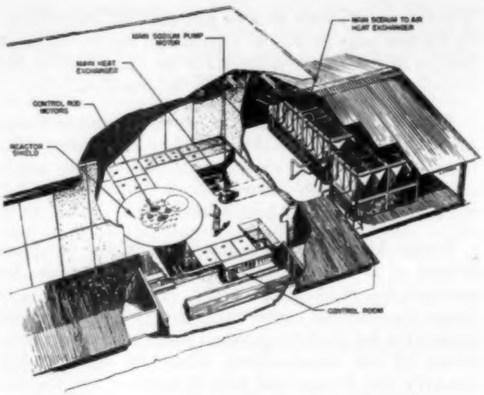
Only those who are south of the 40th parallel, about on a line from Philadelphia to Denver, can see the nova when away from city lights. Now of magnitude 7.5, it is just a bit fainter than the dimmest stars visible to the naked eye, but it can be seen with binoculars or a small telescope.

T. Dale Stewart, physical anthropologist at the Smithsonian Institution, has fitted together the skull fragments of the **most ancient American.** The fragments were found at the prehistoric water hole near Midland, Tex., by an amateur archeologist, Keith Glasscock, of Pampa. The skull, which has been dated by geologic evidence as at least 12,000 yr old, and possibly as much as 20,000, is nevertheless no different from the skull of a modern Indian, according to Dr. Stewart. For this reason, it is believed that the former dating may be more nearly correct.

Standard hospital techniques for **disinfecting scalpels** are often unreliable bacteriologically and also destroy the keenness of the cutting edge. In the July issue of *Surgery, Gynecology and Obstetrics,* Clinton Van Zandt Hawn and Carl W. Walter of Peter Bent Brigham Hospital and Harvard Medical School have reported a sterilization method that does not dull the instrument. Each scalpel is hermetically sealed in a foil package that has been sterilized by dry heat and that can easily be opened by pulling two tabs.

The first **sodium-graphite reactor** in the United States will be developed and constructed in a $10 million project sponsored jointly by the Atomic Energy Commission and North American Aviation, Inc. The reactor, which is expected to be in operation by mid-1957, will be an experimental model of a full-scale power reactor already in the preliminary design stage. It will use metallic fuel elements of either slightly enriched uranium or a combination of thorium and uranium-233.

North American has agreed to assume up to $2.5 million of the total cost and to supply a building site, without charge to the Government, near the company's



Sketch of experimental sodium-graphite reactor.

field test laboratory in the Santa Susana Mountains, north of Los Angeles. The company will operate the facility for approximately 2 yr, but title to the equipment will remain with the Government. Since it is experimental, the plant will generate only about 20,000 kw of heat. This reactor is one of five types on which the AEC is concentrating in its 5-yr program for the development of economic nuclear power.

Scientists in the News

Three newly appointed assistant vice presidents of the U.S. Steel Corp. and their respective fields of responsibility are **James B. Austin,** fundamental research; **Max W. Lightner,** applied research and development; and **Robert W. Holman,** operations research. The appointments were made to implement a reorganization of technical personnel into three separate but coordinated groups.

John S. Burlew, formerly with the Cambridge Corp., Cambridge, Mass., became assistant director of The Franklin Institute 26 July. He also has served with the Carnegie Institution and the Office of Scientific Research and Development.

The following faculty members were added to the Fisk University science departments during the 1953–54 academic year:

Ivar Cooke, research associate in chemistry; **J. Russel Gabel, Woodrow H. Jones,** and **Charles Weise,** assistant professors of biology; **Samuel Proctor Massie, Jr.,** who has recently received a Public Health Service grant for research on carcinogenic compounds, chairman of the chemistry department; **Gertrude F. Rempfer,** associate professor of physics; and **Robert W. Rempfer,** associate professor of mathematics.

Emerson Day has been appointed chief of the preventive medicine division of Sloan-Kettering Institute, Memorial Center for Cancer and Allied Diseases, and professor of preventive medicine at the Sloan-Kettering division of Cornell University Medical College. Since 1950 he has served as director of the Strang Cancer Prevention Clinic at the Center.

Staff members have paid tribute to retired **Vernor Finch,** chairman of the department of geography at the University of Wisconsin from 1928 to 1945, by converting his long-time office into the Finch Seminar Room. Prof. Finch has donated to the department almost 1000 colored slides showing interesting geographic views of the United States and Canada.

Prof. Finch, who received B.S. degrees from Kalamazoo College and from the University of Chicago in 1908, joined the staff at Wisconsin as an assistant in economic geography in 1911. He has served the Government in the Department of Agriculture and on the U.S. Shipping Board. In 1925 he was named to the National Research Council's committee on geology and geography. He is a past president of the Association of American Geographers.

George J. Fischer, formerly a metallurgist at the Western Electric Co., has been named director of the metallurgical department of Sam Tour & Co., Inc., New York.

Frank C. Foley, newly appointed state geologist and director of the State Geological Survey of Kansas, will begin his duties 1 Aug. He will also serve as professor of geology at the University of Kansas. Dr. Foley succeeds **Raymond C. Moore,** who has served as the State geologist for 38 yr. Dr. Moore has been named principal geologist of the Kansas Geological Survey. He will continue as a professor of geology at the university, but will relinquish his duties as chairman of the department. His successor as chairman is **M. L. Thompson** of the University of Wisconsin.

For putting vitamins back into white bread as well as outstanding work in improving other foods, **Charles N. Frey,** retired director of research of Fleischmann Laboratories at Standard Brands, Inc., and at present industrial consultant and lecturer at Massachusetts Institute of Technology, has been honored with the 1954 Nicholas Appert medal. Presentation was made at a special banquet during the recent 14th annual meeting of the Institute of Food Technologists.

Horace W. Gerarde, toxicologist with the Standard Oil Development Co., has been named an honorary associate research specialist in the Rutgers University Graduate School for 3 yr effective 1 July. These honorary appointments, now numbering 7, are limited to persons of distinction in their fields who are rendering specific service in instruction and research at the university. His work at Rutgers is largely concerned with research on biochemistry, pharmacology, and the metabolism of petrochemicals.

Winifred Goldring, state paleontologist with the New York State Museum, Albany, will retire 1 Aug. after 40 yr of service.

Gordon Go Lu has joined the staff of the Johnson & Johnson Research Foundation as senior research associate in charge of the direction of all pharmacodynamic and drug screening work. He will concentrate particularly on the development and application of newer methods of study in pharmacology. Born in Kiangsu, China, he received his M.D. in 1941 at Shanghai. In 1947 Dr. Lu became a member of the faculty at Stanford University School of Medicine; later he received a Ph.D. after 2 yr of study and service at the University of Maryland School of Medicine.

Beno Gutenberg, professor of geophysics and director of the Seismological Laboratory of the California Institute of Technology, has been elected a foreign member of the Geological Society of London in recognition of his "great contributions to seismological science and thus to our understanding of the earth and its structure."

Thomas M. Hahn, Jr., professor of physics at the University of Kentucky, has succeeded **Frank L. Robeson** as head of the physics department at Virginia Polytechnic Institute.

George R. Harrison, dean of science at the Massachusetts Institute of Technology, will address the 7 Sept. meeting of the Franklin Institute RESA branch on the topic "The interferometer-controlled ruling engine." At the 9 Nov. meeting, **Linus Pauling,** of the California Institute of Technology, will speak on the "Structure of proteins." All interested persons are welcome.

Thomas J. Higgins, professor of electrical engineering at the University of Wisconsin, was presented the George Westinghouse award of $1000 for outstanding teaching, one of the nation's highest honors for men in the field of engineering education.

The appointment of **Augustus B. Kinzel** as director of research, Union Carbide and Carbon Corp., became effective 1 July. He has been with the company since 1926.

Charles O. Lee, a professor at the Purdue University School of Pharmacy, retired on 30 June. He first joined the staff in 1915, but in 1920 resigned to spend 5 yr as a medical missionary (pharmacist) with the Methodist Church in China. He returned to his former position at Purdue in 1926. A leave was given to him in 1949–50 to serve as a visiting professor in the College of Pharmacy, University of Puerto Rico. For the coming academic year, Dr. Lee will be visiting professor of pharmacy in the Ohio Northern University College of Pharmacy.

Appointment of **Charles D. Luke** of Syracuse University as director of the Office of Classification has been announced by the Atomic Energy Commission. He will succeed **James G. Beckerley,** who is resigning 31 Aug. to return to private industry. During World War II military service, Dr. Luke was assigned to the Manhattan Engineer District and the Oak Ridge Plant. In his new post he will be responsible for the administration of the AEC's policies for the classification and declassification of atomic energy information.

Jerre L. Noland, biochemist at the Chemical Corps Medical Laboratories, Army Chemical Center, Md., has been appointed chief biochemist of the newly established research laboratory at the Veterans Administration center, Wood, Wisc.

George Morris Piersol is new dean of the Graduate School of Medicine, University of Pennsylvania. He received his M.D. from the U. of P. in 1905, and began his teaching career there 2 yr later. He is best known for his work in physical medicine and rehabilitation of the handicapped. Since its opening last January, Dr. Piersol has been director of the University's Rehabilitation Center for teaching, research, and care of the physically disabled.

Thorndike Saville of New York University's College of Engineering has received the 27th annual Lamme award of the American Society for Engineering Education.

As a token of appreciation for his valuable service to the Chinese people and Government, **Hubert Gregory Schenck** has received the Decoration of Ching Hsing (Auspicious Star). He served for 3 yr as the chief of the Mutual Security Mission to China, first under M.S.A. and later under F.O.A., following many years of work in the fields of geology and paleontology.

New head of the communicable disease section of the preventive division at the Bureau of Medicine and Surgery, Washington, is **John R. Seal,** Cdr, MC, USN.

Ralph R. Shaw, chief librarian of the U.S. Department of Agriculture, has been appointed professor of library service in the Graduate School of Library Service at Rutgers University.

H. Horton Sheldon, formerly dean of the division of research and industry, University of Miami, Florida, has been appointed consultant to the Organization for European Economic Cooperation, with headquarters in Paris.

Fordham University announced the appointment of **Albert J. Sica** as associate dean of the College of Pharmacy. He will continue as associate professor and chairman of the department of pharmacy.

Francis Scott Smyth resigned as dean of the University of California School of Medicine, San Francisco, 1 July. He will continue as professor of pediatrics in the school.

Alan P. Stansbury, formerly of the National Bureau of Standards, has joined the staff of the Edison Research Laboratory, West Orange, N.J., where he will initiate electronics research and design as required by the various studies being conducted by the laboratory.

Alex J. Steigman, professor of child health, has been appointed chairman of the department of pediatrics at the University of Louisville School of Medicine, where he has taught for the past 4 yr. In addition to serving as chief of pediatrics of the Louisville General Hospital, Dr. Steigman will be physician-in-chief at Children's Hospital, a 150-bed affiliated institution.

Jacinto Steinhardt, director of the Operations Evaluation Group in the Office of the Chief of Naval Operations and of the Operations Research Group in the Office of Naval Research, has been elected president of the Operations Research Society of America. Both of the groups that he directs are administered by the Massachusetts Institute of Technology, where he is currently investigating the acid denaturation of ferrihemoglobin.

Appointment of **Chester Bryant Stewart** as dean of medicine at Dalhousie University, Halifax, N. S., has been announced. Dr. Stewart was compelled to asume his new duties earlier than had been anticipated because of the sudden death of Dean **H. G. Grant,** a member of the faculty of Medicine since 1932.

The New York Botanical Garden has presented distinguished service awards to **A. B. Stout** for his investigations and accomplishments in plant breeding and in recognition of his ability to combine theoretical botany with practical plant improvement; and to **John C. Wister** for his service to horticulture.

R. K. Stratford, scientific advisor to Imperial Oil Ltd. and president of the Research Council of Ontario, has won The Chemical Institute of Canada Medal for 1954, which is awarded annually for outstanding contributions to Canadian chemistry and chemical engineering. Dr. Stratford is noted for his research in the petroleum field, particularly for work that resulted in the use of phenol as a selective solvent for extracting lubricating oil. About one-half of the world's supply of lubricating oil is now produced by this process.

Emil Truog retired 1 July after 45 yr in the soils department, College of Agriculture, University of Wisconsin. Prof. Truog, a graduate of the College of Agriculture in 1909, joined the Wisconsin staff as a graduate assistant in the soils department, where he worked for his M.S. degree and later taught. He served as chairman of the department of soils from 1939 to 1953. Prof. Truog is a past president of the American Society of Agronomy, and at present is serving as president of the Soil Science Society and vice president of the Wisconsin chapter of the Soil Conservation Society of America. He also has been a member of a committee of the Food and Agricultural Organization of the UN.

Thirteen veteran scientists and engineers at Ohio State University, whose campus service totals 453 yr, will retire from active duty this summer. Heading the list in terms of service are **William D. Turnbull,** junior dean of the College of Engineering, and **E. J. Gordon,** clinical professor in the department of medicine, both with 44 yr at Ohio State.

Others are **Cecil E. Boord,** research professor in the department of chemistry, 42 yr; **Charles W. Strosnider,** College of Dentistry, 41 yr; **Harry E. Nold,** department of mining and petroleum engineering, 38 yr; **James D. Grossman,** chairman of the department of veterinary anatomy, 35 yr; **Vaughn B. Caris,** department of mathematics, 34 yr; **Arthur C. Kennedy,** department of agricultural engineering, 34 yr; **John M. Montz,** department of civil engineering, 32 yr; **Grace A. Stewart,** department of geology, 31 yr; **John C. Prior,** department of civil engineering, 30 yr; **George A. Bole,** department of ceramic engineering and Engineering Experiment Station, 28 yr; and **Frank A. Hartman,** department of physiology, 20 yr.

Geoffrey A. Wheatley, scientific officer at the National Vegetable Research Station in Wellesbourne, Warwickshire, England, will spend the next 4 mo in the entomology department of the Connecticut Agricultural Experiment Station. The W. H. Kellogg Foundation has awarded him a fellowship for 6 mo study and research in the United States.

Three scientists at the U.S. Department of Agriculture's Eastern Regional Research Laboratory in Wyndmoor have received the Superior Service award, the Department's second highest honor, for their development of a process for intensifying the flavor of maple syrup. They are **Charles O. Willits, William L. Porter,** and **Margaret L. Buch.**

Meetings

The **American Academy of Dental Medicine** will hold its 9th mid-annual meeting and luncheon at the Hotel Statler in New York City on Dec. 5. There will be a business meeting for members at 10:30 A. M. Following the luncheon, there will be a symposium on bone, with papers by Harry Sicher on "Bone formation and resorption"; by J. P. Weinmann on "Variations in the structure of bone tissue and their significance in radiology"; and by Lester Cahn on "The correlation between clinical, roentgenologic and histologic studies in bone lesions." All members and interested dentists and physicians are cordially invited. For reservations and programs address the national secretary, Dr. William M. Greenhut, 124 East 84 St., New York 28.

At the meeting of the **American Society of Limnology and Oceanography,** Pacific Section, in Pullman, Wash., on 23 June, 15 papers were presented. These covered a wide range in the oceanographic and limnological fields, including a discussion of terminologies, biological studies of lake populations, the determination of strontium in sea water, physical oceanography of inlets, and the effect of high pressure on marine bacteria. Some 25–40 members and guests participated.

At the annual business meeting the following officers

were elected: pres., M. B. Schaeffer, Scripps Institution of Oceanography, La Jolla, Calif.; v. pres., E. C. LaFond, U.S. Navy Electronics Laboratory, San Diego, Calif.; sec.-treas., G. L. Pickard, University of British Columbia, Vancouver.

Papers ranging from basic theories of light and vision through many of the application fields will be presented before the national technical conference of the **Illuminating Engineering Society,** 13–18 Sept., at the Chalfonte Haddon Hall Hotel in Atlantic City.

The first national meeting of the **Institute of Radio Engineers' Professional Group in Nuclear Science** will be held in Chicago on 6–7 Oct. jointly with the National Electronics Conference.

The program will consist of invited and contributed papers. Among the invited speakers are Alvin M. Weinberg, Oak Ridge National Laboratory; W. M. Brobeck, Radiation Laboratory, Berkeley, Calif.; Lyle B. Borst, University of Utah; Robert Vestergaard, Stockholm, Sweden; J. Walker, A.E.R.E., Harwell, England; and W. B. Lewis, A.E.C.L., Chalk River, Ontario, Canada. For further information communicate with S. Goslovich, Argonne National Laboratory, Box 299, Lemont, Ill.

The **Mathematics Division of the American Society for Engineering Education** met on 16–18 June. Four well-attended sessions were held. The following officers were elected at the annual business meeting: chairman, C. O. Oakley, Haverford College; sec., W. E. Restemeyer, University of Cincinnati; director, R. S. Burington, Bureau of Ordnance, Navy Department. H. M. Gehman, University of Buffalo, and C. V. Newsom, State University of New York, will continue to serve as directors and H. K. Justice, University of Cincinnati, continues as council member of ASEE. The next annual meeting of the ASEE Mathematics Division will be held in June 1955 at Pennsylvania State University. For further information write to Prof. W. E. Restemeyer, University of Cincinnati.

Reduction of machinery noise in industry will be the theme of the 5th annual **National Noise Abatement Symposium** to be held 21–22 Oct. at the Illinois Institute of Technology. More than 300 industrial, civic, and research leaders are expected to attend.

The **Swedish Medical Association** celebrated its 50th anniversary in Stockholm, 18–20 June, in the presence of 300 physicians and scientists and some 30 foreign guests. Nuclear radiation as an aid to medical science and proposed measures for protection against injuries from atomic radiation were among the subjects discussed. It was revealed that among treatments tried at Radiumhemmet (the Radium Home) of Stockholm, phosphorus radiation has proved beneficial against polycythemia and other blood diseases, while radioactive iodine has been useful for goiter troubles. Cancerous disturbances in the lymphatic glands have been treated with radioactive colloidal elements. The danger of destroying the genetic elements in the human race by subjecting it to strong radiation was emphasized by one of the speakers.

Some 50 examples of American industrial design have been shipped to Italy, where they will be displayed at the **10th Triennale Fair** in Milan, an important international exhibition. Industrial design is the major theme of this year's fair, which will run from 25 Aug. to 15 Nov.

A **World Symposium on Applied Solar Energy** will be held at Phoenix, Ariz., Jan. 12–15, under the leadership of Stanford Research Institute. The Association for Applied Solar Energy—formed last March by a group of Southwestern industrialists, bankers, agriculturists and educators—is sponsoring the meeting, which will be under the general chairmanship of Lewis W. Douglas, former ambassador to Great Britain and chairman of the board of Southern Arizona Bank and Trust Co. Merritt L. Kastens, assistant director of Stanford Research Institute, is vice chairman.

Major centers of solar energy research in the United States will be represented, and arrangements are being made for presentations by solar scientists from England, France, Germany, India, Japan, Australia, and South Africa.

Education

Mechanical and electrical devices can be used to improve instruction in arithmetic, spelling, and reading in the lower elementary grades, writes B. F. Skinner professor of psychology, Harvard University, in a recent issue of the *Harvard Education Review.* "We have every reason to expect," he says, "that the most effective control of human learning will require instrumental aid. The simple fact is, that as a mere reinforcing mechanism, the teacher is out of date. . . . She must have the help of mechanical devices."

Medical education has expanded considerably since 1945, according to an article in the July issue of *The Journal of Medical Education.* Since then three medical schools have opened, at the universities of Washington, California at Los Angeles, and Miami; the universities of Alabama and North Carolina, have expanded to 4-yr curriculums; and Chicago Medical College has gained approval. There are now 79 approved medical schools in the United States.

G. Ralph Spindler of the West Virginia University School of Mines reports that the number of college freshman throughout the country planning a career in **mining engineering** increased 19 percent this past year. There are 29 accredited mining institutions in the country.

The fall session of the **Norelco X-ray Diffraction School,** which has been held for the past 8 yr in the New York area, will take place this year at the

Knickerbocker Hotel, Chicago, during the week of 25–29 Oct. Since the National Metals Show will be held in Chicago the week of 1–5 Nov. in the International Amphitheatre, the company expects a number of show visitors to come early in order to attend the school. No fee will be charged. Those who wish to participate are urged to enroll promptly since accommodations will be limited.

A new undergraduate program to train badly needed community health educators will be launched this September by the School of Public Health on the Los Angeles campus of the University of California. It will be a 2-yr upper division curriculum designed to prepare students for positions in the **public health** field and for graduate work leading to careers as public health educators. Graduates will receive the B.S. degree in public health. After 3 yr of experience in the field, they will be qualified for training leading to a master of public health degree.

Rutgers University plans to establish a **Radioisotope Center** to provide instruction in the use of radioisotopes for industrial, agricultural, and fundamental research. First step will be to set up a basic course similar to that provided at Oak Ridge. Initial financing of the proposed center would be by $1000 memberships from New Jersey concerns, several of whom have already indicated their support.

C. Ladd Prosser of the University of Illinois and Marston Bates of the University of Michigan will each spend 5 wk at **Stanford University's Marine Station** in Pacific Grove, where they will deliver the annual Timothy Hopkins lectures. These are part of the regular teaching program and were established by the station to honor its founder.

Prof. Prosser and Arthur C. Giese of Stanford have collaborated on a course in comparative physiology during the first half of the summer session; and in the final half, Prof. Bates will give a series of lectures on interrelationships between the biological and social sciences.

The **University of Texas** has announced the addition of the Ph.D. degree in pharmacy to the degrees offered through its College of Pharmacy. This brings to four the number of Ph.D. degrees offered by the College of Pharmacy, the remaining three being available in the fields of pharmaceutical chemistry, pharmacognosy, and pharmacology.

Grants and Fellowships

The **Arctic Institute of North America** is sponsoring the following projects this summer.

A Bursa, New York City. Annual cycle of phytoplankton production in the Arctic Ocean.

P. A. Dehnel, dept. of zoology, University of California. Productivity of organic matter in the sea, with particular reference to the waters in the vicinity of Mt. Edgecombe, Alaska.

R. L. Edwards, Waltham, Mass. Hydrographic and ecological studies of 4 representative marine areas in James Bay and Hudson Bay, Canada. Analysis of water exchange between Richmond Gulf and Hudson Bay.

D. V. Ellis, dept. of zoology, McGill University. Distribution and ecology of the littoral and shallow water fauna and flora of the Canadian Arctic.

D. B. Ericson, Lamont Geological Observatory, Columbia University. Micropaleontological, petrographic, and chemical examination of sediment cores from arctic and subarctic waters as factors reflecting climatic shifts, ocean current circulation, and glaciology.

G. D. Hanna, dept. of geology, California Academy of Sciences. Geology of the continental shelf in the vicinity of Point Barrow, Alaska.

R. Mazzeo, Massachusetts Audubon Society. Ornithology, botany, geology, and geomorphology of certain portions of Bylot Island.

R. H. McBee, Montana State College. Thermophilic bacteria in arctic soils and waters in the vicinity of Point Barrow, Alaska.

J. L. Mohr, dept. of zoology, University of Southern California. Ecology of arctic crustaceans with emphasis on the interrelations with the fish population.

D. C. Nutt, Dartmouth College Museum. Hydrobiological study in the coastal waters of Labrador.

G. C. Ray, dept. of zoology, Columbia University. Environmental zoological investigations in the vicinity of Juneau, Alaska.

R. W. Rex, Scripps Institute of Oceanography. Oceanographic and limnological investigations at Point Barrow, Alaska.

P. F. Scholander, Woods Hole, Oceanographic Institution. Osmotic pressures in the blood of arctic and subarctic marine fishes.

J. Sonnenfeld, Bowman dept. of geography, The Johns Hopkins University. Changes in subsistence economy among Point Barrow Eskimo.

W. C. Steere, dept. of biological sciences, Stanford University. Conclusions derived from consultation with specialists and investigations of specimens in European institutions, in direct connection with bryological problems arising from W. C. Steere's arctic field work.

D. Q. Thompson, dept. of zoology, University of Missouri. Ecology of the lemmings in the vicinity of Point Barrow, Alaska.

I. L. Wiggins, Natural History Museum, Stanford University. Comparison of collections made in Arctic Alaska with authentic specimens in U.S. herbaria and completion of an account of the systematics and ecology of the seed plants occurring in the Petroleum Reserve No. 4.

R. T. Wilce, dept. of botany, University of Michigan. Marine flora in the Strait of Belle Isle, Newfoundland.

N. J. Wilimovsky, Natural History Museum, Stanford University. Survey of fishes of Arctic Alaska with particular reference to those of importance to the military and naval services; determination of the relative nutriment content of ice-melt waters in the vicinity of Point Barrow, Alaska, and in comparison with similar factors in neighboring open seas.

D. E. Wohlschlag, Natural History Museum, Stanford University. Usefulness of fishery resources and the determination of the nature and extent of fish stocks of individual species in the waters of Arctic Alaska on morphological, ecological and physiological bases.

Research grants and fellowship awards of the **Damon Runyon Memorial Fund,** announced in June, amounted to $143,100.

Sloan-Kettering Institute: A. E. Moore and H. W. Toolan. Preclinical studies of viruses as antineoplastic agents, $25,000; C. P. Rhoads, R. W. Rawson, and J. E. Rall. Serum iodine and serum protein in relation to thyroid function and to treatment with radioiodine, $11,000.

Columbia University, College of Physicians and Surgeons. H. C. Taylor and S. Lieberman. Cytochemistry and biochemistry of differentiation in human neoplastic disease, $23,900.

New York University, Bellevue Medical Center. N. Nelson and W. E. Smith, Chemical nature of environmental carcinogens, $11,500.

Polytechnic Institute, Brooklyn. D. Harker. Protein structure project, $15,000.

Massachusetts Institute of Technology. J. M. Buchanan. Enzyme systems and the purification and isolation of enzymes involved in the synthesis of nucleo-proteins, $11,000.

Tufts College Medical School. F. Homburger. Tumor growth in hormone-susceptible transplantation sites, $8400.

University of Colorado. R. C. Lewis. Some endocrinological aspects of neoplasia and physicochemical characterization of biologically specific macromolecules, $14,500.

Cancer Institute, Miami, Fla. C. G. Grand. Effects of antibiotics and chemotherapeutic agents on carcinoma *in situ* and related tissue culture studies, $10,700.

University of Louisville. J. B. Rogers and R. C. Taylor. Carcinogenesis in tumor-susceptible guinea pigs, $6700.

Fellowship renewal

J. C. Opsahl, with W. C. MacKenzie. University of Alberta. Training for correlation between clinical studies and basic endocrinology, $5400.

Eight fellowships for study at the Guggenheim Jet Propulsion Center, Princeton University, have been awarded by the **Daniel and Florence Guggenheim Foundation.**

Renewals

A. F. Burke, Pittsburgh, and S. M. Scala, Chester, Pa.

New awards

R. Hirschkorn, Lynn, Mass.; P. Lieberman, Brooklyn, N. Y.; S. H. Lam, Bronx, N. Y.; D. A. Mahaffy, Wichita Falls, Tex.; and E. S. Wilson, Xenia, Ohio.

Four winners of **Howard Hughes fellowships** in science and engineering, established for the training of research engineers and physicists at the California Institute of Technology, have been announced. Recipients and their fields are George S. Campbell, mathematics and aeronautics; Roy W. Gould, electromagnetic theory; James E. Mercereau, solid state physics; James W. Sedin, microwave tubes.

A number of fellowships for the academic year 1954–55 are available for the support of research at the **International Children's Centre,** Paris. At present the program there deals primarily with problems of antituberculosis vaccination and antipertussis immunization. The grants amount to 60,000 French francs per month. Traveling expenses will have to be borne by the recipient. An application, together with curriculum vitae, record of previous work, and testimonials from department heads should be sent to Prof. Bugnard, International Children's Centre, Chateau de Longchamp, Paris 16.

The **Jane Coffin Childs Memorial Fund** for Medical Research has announced the following appropriations, totaling $258,329, made by its Board of Managers in Oct. 1953, Feb. 1954, and May 1954 for support of cancer research projects and fellowships.

Projects

S. C. Finch, Yale University School of Medicine. Immunologic mechanisms in leukemia, 1 yr, $4200.

W. H. Gaylord, Jr., and S. L. Palay, Yale University School of Medicine. Intracellular development of virus particles and its relation to neoplasia, 1 yr, $5000

G. C. Godman, College of Physicians and Surgeons, Columbia University. Effects of certain metabolites, as illustrated by cytochemistry, on nucleic acid and protein synthesis, 1 yr, $4324.

M. W. Gordon, Institute of Living, Hartford. Adaptive enzyme formation in the embryo chick, 2 yr, $14,500.

H. S. N. Greene, Yale University School of Medicine. Biological study of cancer, 3 yr, $76,440.

A. Haddow and associates, Royal Cancer Hospital, London. Chemistry, virology, and chemotherapy of cancer, 1 yr, $5000.

H. Kaplan, Stanford University School of Medicine. Intermediate phases of lymphoid tumor induction, 1 yr, $12,800.

L. L. Miller, University of Rochester School of Medicine and Dentistry. (i) Physiological chemical studies of protein synthesis as related to neoplastic growth, and (ii) Steroid hormone metabolism in normal and tumor-bearing animals, 3 yr, $67,500.

J. Monod, Institut Pasteur, Paris. Synthesis of specific proteins in cellular growth, 1 yr, $10,400.

National Research Council, U.S. National Committee on the International Union Against Cancer. (i) Contribution to U.S. portion of expenses of the union, $500. (ii) Allotment toward expenses of four U.S. scientists to attend VIth International Cancer Congress in São Paulo, $2400.

E. Schwenk, Worcester Foundation for Experimental Biology. Biogenesis of cholesterol and companion substances in cancerous and noncancerous rats in various endocrine states, 3 yr, $23,415.

E. L. Tatum, Stanford University. Biological and enzymatic effects of chemical carcinogens in inducing mutations, 2 mo, $850.

H. W. Toolan, Sloan-Kettering Institute for Cancer Research. Propagation of transplantable human tumors in animals, 1 yr, $10,000.

L. L. Weed, Yale University School of Medicine. Pyrimidine metabolism in human tumors, 3 yr, $16,500.

Fellowships

J. T. Hakala, Yale University School of Medicine, with A. Welch, $4000.

P. A. Srere, Yale University School of Medicine, with E. Racker, $500.

Effective 1 July, 32 organizations and institutions received awards from the **National Foundation for Infantile Paralysis.** The awards will be used for both research and professional education.

Virus research

California Institute of Technology. L. Pauling, dept. of chemistry, $32,126.

California State Department of Public Health. E. H. Lennette, Viral and Rickettsial Disease Laboratory, $41,284.

University of California. W. M. Stanley, Virus Research Laboratory, $144,473.

Camden Municipal Hospital, N. J. L. L. Coridell, $69,930.

University of Colorado. T. T. Puck, dept. of biophysics, $19,430.

Connaught Medical Research Laboratories, Toronto. R. D. Defries, $179,025.

Florida State Board of Health. A. V. Hardy, Bureau of Laboratories, $18,280.

Institut Pasteur, Paris. A. M. Lwoff, dept. of microbial physiology, $16,670.

Johns Hopkins University. K. F. Maxcy, dept. of epidemiology, $133,472.

Johns Hopkins University. M. M. Mayer, department of microbiology, $43,550.

University of Kansas. H. A. Wenner, dept. of pediatrics, $105,111.

University of Minnesota. J. T. Syverton, dept. of bacteriology and immunology, $74,870.

New York University–Bellevue Medical Center, M. H. Adams, dept. of microbiology, $16,173.

University of Pennsylvania. G. W. Rake, dept. of microbiology, $198,495.

Washington University. B. Commoner, dept. of plant physiology, $26,330.

Western Reserve University. L. O. Krampitz, dept. of microbiology, $49,044.

Yale University. J. R. Paul, dept. of preventive medicine, $129,356.

Prevention of polio and treatment of its after-effects

Children's Medical Center, Boston. W. T. Green, dept. of orthopedic surgery, $23,798.

Columbia University. A. L. Barach, dept. of clinical medicine, $25,394.

Harvard University. J. L. Whittenberger, dept. of physiology, $57,398.

University of Maryland. J. E. Finesinger, dept. of psychiatry, $28,455.

Massachusetts General Hospital. H. K. Beecher, dept. of anesthesiology, $44,954.

Tulane University. H. W. Kloepfer, dept. of anatomy, $8030.

Professional education and recruitment of medical service workers

American Association of Medical Social Workers. M. L. Hemmy, $52,735.

American Occupational Therapy Association. M. Fish, $19,500.
American Physical Therapy Association. M. Elson, $66,715.
Creighton University. H. N. Neu, dept. of medicine, $114,436.
Duke University. J. E. Markee, dept. of anatomy, $38,875.
Duke University. L. D. Baker, $2467.67.
Mary Imogene Bassett Hospital, Cooperstown, N. Y. J. Bordley III, $5319.
Meharry Medical College. E. P. Crump, dept. of anatomy, $20,500.
Meharry Medical College. M. Walker, dept. of surgery, $18,600.
Meharry Medical College. G. B. Brothers, dept. of medicine, $5300.
National League for Nursing. A. Fillmore, $201,557.
New York University College of Medicine. H. A. Rusk, dept. of physical medicine and rehabilitation, $22,680.
New York University College of Medicine. E. C. McEwan, $9720.
University of Oklahoma. C. L. Cross, $6504.35.
University of Southern California. C. W. Anderson, dept. of physical therapy, $5810.
University of Southern California. A. A. Howard, dept. of occupational therapy, $12,476.
Western Reserve University. J. T. Wearn, $230,600.
D. T. Watson School of Physiatrics, Leetsdale, Pa., $21,300.

The Surgeon General of the U.S. Public Health Service has announced a predoctoral research fellowship program at the **National Institutes of Health.** These fellowships in health, medical sciences, and related fields are open to candidates with bachelor's or master's degrees or equivalent training. Stipends are awarded in accordance with the year of training after the bachelor's degree: first year, $1400; intermediate year, $1600; terminal year, $1800. In addition, basic tuition and certain travel expenses are paid, and there is a $350 allowance for spouse and each dependent child. Apply at any time to the Research Fellowships Branch, Division of Research Grants, National Institutes of Health, Bethesda 14, Md.

Three **Westinghouse Electric Corp.** engineers have received 1-yr graduate scholarships. They are David B. Breedon and Loren F. Stringer of the East Pittsburgh plant and Robert C. Ohlmann of the Westinghouse Research Laboratories. Each award is valued at about $2500 plus an allowance for tuition and fees. In addition to meeting the educational requirements for the awards, recipients must have had at least 2 yr of service with Westinghouse. They have their choice of any accredited university in the United States, Canada, or Europe, subject to final approval by the scholarship committee.

The **Williams-Waterman Fund,** which is administered by the Research Corp., has announced the award of 11 grants, totaling $79,730, to combat dietary diseases.

Clemson Agricultural College. E. J. Lease. Improvement of nutritive value of certain staple southern foods, $8000.
Tulane University. G. Goldsmith. Clinical investigation of nutritional diseases, $9500.
National Research Council. Food and Nutrition Board, $7500.
Columbia University. M. L. Caldwell. Relationship of amylase activity of crystalline swine pancreatic amylase to its chemical structure, $3600.
Fundacion de Investigaciones Medicas, Havana. L. F. Smith. Enrichment of cereals for Cuba, $5000.
University of Pittsburgh. R. E. Olson. Metabolic role of vitamin E in the prevention of liver injury, $4800.
Washington University. H. B. Burch. Riboflavin enzymes, $10,720.
American Bureau for Medical Aid to China, Inc. T. C. Tung, National Taiwan University, and others. Enrichment of white rice in Formosa and new equipment for National Defense Medical Center and clinical surveys, $12,000.
Merrill Palmer School, Detroit. I. M. Hoobler. Completion of publication of research performed under the Children's Fund of Michigan, $8850.
College of Medical Evangelists. B. W. Halstead. Poisonous fishes and their relationship to protein food sources, $1800.
National Multiple Sclerosis Society. H. Sobotka, Mount Sinai Hospital. Vitamins in the cerebrospinal fluid in multiple sclerosis, $7960.

In the Laboratories

The **Bersworth Chemical Co.** of Framingham, Mass., manufacturer of amino acid chelating agents, has announced that the name of the company has been changed to "**Versenes Incorporated.**" No other change in name, structure, or personnel of the concern is contemplated.

A $1,275,000 research laboratory for the film department of the **Du Pont Co.** is to be built at the company's experimental station in Wilmington. The new laboratory, which will accommodate approximately 45 employees, will be devoted primarily to exploratory research in synthetic polymers for the general field of packaging and industrial films. It is scheduled for completion by the end of 1955.

Expansion of the **Hercules Powder Co.** synthetic resins plant at Burlington, N.J., will be completed in 1954 and will double the output of Abitol, technical hydroabietyl alcohol. Largest single use of Abitol is in petroleum additives. Also under construction at Burlington is a $4,000,000 plant for the production of dimethyl terephthalate (DMT), basic raw material for polyester fiber.

Construction has begun on **Jones & Laughlin Steel Corp.'s** new $1,500,000 research center. The facility, to be completed in mid-1955, will consist of several buildings that can house a research staff of approximately 100 persons. The more theoretical aspects of J&L's research will be moved into the new location, which is 15 min from downtown Pittsburgh. Research at most of the existing installations will be continued—metallurgical research at the Pittsburgh Works research laboratory, coal and coke research at Aliquippa Works, and ore research at Negaunee, Mich.

Stockholders of Olin Industries, Inc. and Mathieson Chemical Corp. voted to approve the merger of the two companies, both founded in 1892, to form the **Olin Mathieson Chemical Corp.** The new corporation will have approximately 36,000 employees, 43 plants in 24 states in this country, and 16 plants in foreign countries.

Developmental **research in India** made a big forward step with the official opening of the first building of the Central Laboratories for Scientific and Industrial Research in Hyderbad, Deccan, early this year. Main purpose of the laboratories is to carry out develop-

mental research and to adapt the results to the industrial needs of the area. Research sections deal with fuels, heavy chemicals and fertilizers, chemical engineering, physical chemistry and x-rays, oils, ceramics, paper and fibers, entomology, biochemistry, organic chemistry, pharmaceuticals, and drugs.

The first of the new facilities at the **U.S. Naval Radiological Defense Laboratory** in San Francisco is now in operation, a two-story structure housing a Van de Graaff accelerator, a laboratory, and offices. The second building is a six-story main laboratory, which should be ready for occupancy in the spring of 1955.

A multi-million-dollar sound laboratory and test center for large, high-power transformers will be built at the transformer division plant of **Westinghouse Electric Corp.**, Sharon, Pa. The laboratory will be 70 ft long, 56 ft wide, and 55 ft high; it will have a 3-ft-thick concrete floor. The 5-ft-thick walls will be made of concrete, several inches of air space, and Fiberglas. The inside walls will be covered with Fiberglas wedges and wire mesh, egg crate style to prevent reflection of sound. Metallic shielding will exclude interfering radio waves from the laboratory.

The soundproof room will be large enough to test transformers weighing up to 400 tons and with power ratings exceeding 500,000 kv amp, larger and more powerful than any transformers now being manufactured.

Necrology

Martin E. Adamo, 72, president of the New England College of Pharmacy, Jamaica Plains, Mass., 4 July; **George A. Blakeslee,** 74, retired director of neurology and psychiatry at the New York Postgraduate Medical School, New York City, 9 June; **Ludlow Bull,** 68, Egyptologist, author, professor, and associate curator at the Metropolitan Museum of Art, New York City, 1 July; **José Angel Caparo,** 66, author and former professor of electrical engineering at the University of Notre Dame, Notre Dame, Ind., 12 July; **Karl T. Compton,** 66, research physicist, author, former president of the American Association for the Advancement of Science, of the American Society for Engineering Education, and of the American Physical Society, retired chairman of the Research and Development Board of the National Military Establishment, and chairman of the corporation of the Massachusetts Institute of Technology, Cambridge, Mass., 22 June; **Howard Dittrick,** 77, author, editor, and founder of the Historical Museum of the Cleveland Medical Library Association, Cleveland, Ohio, 11 July; **Saul Dushman,** 71, physical chemist, authority on high vacuum research, and retired assistant director of the General Electric Research Laboratory, Schenectady, N.Y., 7 July; **Jan J. L. Duyvendak,** author, professor, and Sinologist, Leyden, Netherlands, 9 July.

Egon W. Fischmann, 69, chairman of the department of obstetrics and gynecology at the Chicago Medical School, Chicago, Ill., 13 June; **Allen W. Freeman,** 73, epidemiologist, author, professor, and former dean of The Johns Hopkins School of Hygiene and Public Health, Baltimore, Md., 3 July; **Joseph E. Greaves,** 74, author, professor emeritus, and former head of the department of bacteriology and biochemistry at the Utah State Agricultural College, Logan, Utah, 6 June; **F. Ross Haviland,** 74, author and former clinical professor of psychiatry at the Long Island College of Medicine, L.I., N.Y., 27 June; **Melvin Henderson,** 71, professor and founder of the Orthopedic Surgery Section of the Mayo Clinic, Rochester, Minn., 17 June; **Ernest E. Hubert,** 66, author, authority on wood decay, lecturer and research pathologist at the College of Forestry, University of Idaho, Moscow, Idaho, 2 June; **George W. Kosmak,** 80, gynecologist, author, editor, and former president of the American Gynecology Society, New York City, 10 July; **Carl W. Larson,** 73, first chief of the Bureau of Dairy Industry, U.S. Department of Agriculture, Buffalo, N.Y., 13 June; **Sidney O. Levinson,** 50, pioneer in antipolio and blood serum research, assistant professor at the University of Illinois School of Medicine, and executive director of the Michael Reese Research Foundation, Chicago, Ill., 20 June; **James O. Lewis,** 68, petroleum geologist and former chief technologist for the U.S. Bureau of Mines, Houston, Tex., 15 June; **Perry M. Lichtenstein,** 67, psychiatrist, criminologist, and author, New York City, 14 June; **David G. McCaa,** 72, pioneer in radio telephony and civilian engineer for the Army Signal Corps, Fort Monmouth, N.J., 22 June; **Edward E. Marbaker,** 66, chemist and senior research fellow at the Mellon Institute, Pittsburgh, Pa., 2 June.

Marks Neidle, 63, industrial chemist, former professor of physical chemistry at the University of Pittsburgh, and president of Timeproof Paint Products, New York City, 4 July; **Hugo B. C. Riemer,** 78, surgeon and associate professor of ophthalmology at the Harvard Medical School, Boston, Mass., 10 July; **Herman A. Spoehr,** 69, author, investigator of photosynthesis, and retired chairman of the Carnegie Institution's Division of Plant Biology at Stanford University, Stanford, Calif., 21 June; **C. M. A. Stine,** 71, former professor, research chemist, and retired director for the Du Pont Co., Wilmington, Del., 28 May; **Joseph C. Tucker,** chief of the Administrative Division, Armed Forces Medical Library, Washington, D.C., 18 June; **John R. West,** 36, investigator in heart and lung diseases, assistant professor of medicine at the Columbia University's College of Physicians and Surgeons, New York City, 29 June; **Herbert L. Whittemore,** 77, inventor, author, former professor, and retired chief of the Engineering Mechanics Section of the National Bureau of Standards, Washington, D.C., 11 July; **Ralph G. Wright,** 79, retired professor of chemistry at Rutgers University, New Brunswick, N.J., 21 June; **Sergei Yudin,** 64, expert in the surgical treatment of diseases of the lungs and stomach, and on blood transfusion, Moscow, Russia, 14 June; **Warren H. Yudkin,** 30, assistant professor of chemistry at Northwestern University, Evanston, Ill., 6 June.

Book Reviews

Science and the Common Understanding. J. Robert Oppenheimer. Simon and Schuster, New York, 1954. 120 pp. $2.75.

This volume represents the substance of the Reith Lectures delivered over the home service of the British Broadcasting Corporation from London in Nov. and Dec. 1953 by the director of the Institute for Advanced Study in Princeton. The theme of the book is the author's expression of confidence that new scientific discoveries, particularly in atomic physics, can supply valuable analogies to human problems not normally thought to be susceptible of scientific treatment.

The book opens with a historical sketch of 17th and 18th century science and its influence on human thought exemplified, among other things, by the great growth of scientific societies seeking to extend the boundaries of precise knowledge and expressing assurance that this knowledge could be applied to human betterment. But scientific ideas are not restricted to immediate application: more significantly, they lead on to newer and more general concepts. This is well brought out by the author in his story of Rutherford's use of the alpha particle as a tool in the building of a more convincing theory of atomic structure. The tale, set forth by and large in clear, simple, and elegant prose, is brought down to present-day nuclear physics with its plethora of "elementary" particles.

Not so successful, unfortunately, are the third and fourth chapters in which an attempt is made to convey to a lay audience the development of modern atomic physics based on the quantum theory and to do it, moreover, in a mere 30 pages of text. This business, and in particular the problem of the dual description in terms of waves and particles, seems so far to defy nontechnical presentation in nonmisleading fashion.

In the last two chapters, Oppenheimer comes to grips in vigorous fashion with his fundamental thesis, using as the peg on which to hang it the famous complementarity principle of Bohr. In rhythmic prose of attractive literary quality and with impressive sententiousness in his philosophical "asides," he stresses the possible application of the complementary and mutually exclusive modes of description inherent in the presently accepted version of quantum mechanics to numerous problems in other sciences and in human affairs generally. The grand antinomy of the individual and the community, in some ways the crux of all human problems, comes in for considerable attention. As far as science is concerned, one gathers that the author has the firm conviction that knowledge is good for its own sake and that this transcends the human difficulties involved in its so-called "practical" application. He expresses his faith, to use his own words, in "the open society, the unrestricted access to knowledge, the unplanned and uninhibited association of men for its furtherance." It is likely that scientists generally will echo this sentiment.

Although the general argument impressed me, I cannot refrain from voicing a doubt about the appropriateness of seeking such weighty conclusions from the complementarity principle. It is an ingenious idea and basic to the currently prevailing interpretation of quantum mechanics, but there is no assurance that it will continue to maintain its scientific status. Several prominent theorists have raised objections to the probability and indeterministic interpretation of quantum theory on which it rests, and if in the future this interpretation should be altered—by no means an unheard-of type of occurrence in the history of physics—the principle of complementarity might well lose its cogency. This would not necessarily invalidate Oppenheimer's conclusions, but it would spoil a clever argument. One cannot help feeling that reasoning by analogy in science and philosophy, although tempting and often helpful, is nevertheless a somewhat tricky business. It has in this instance, at any rate, provided an entertaining and provocative exposition.

R. B. Lindsay

Department of Physics, Brown University

Pathology. W. A. D. Anderson, Ed. Mosby, St. Louis, ed. 2, 1953. 1393 pp. Illus. + color plates. $16.

With minor modifications, this new edition is similar to the first edition. There has been a change from single-column to double-column page; illustrations have been increased and, as in the first edition, are of good quality. The total length of the book has been shortened by about 50 pages. Unfortunately, a large amount of type has been reduced in size, making reading a bit more difficult. Aside from the foregoing, there is no extensive general revision. However, additions have been made where necessary, particularly in the section on diseases of the nervous system where previous deficiencies have been largely corrected.

In general, the second edition maintains the same standard and inclusive excellence as the previous volume. However, this second edition is even more of a book for the pathologist than for the medical student. The editor seems to indicate this in the preface where he proposes that the teacher supply the deficiencies, these being chiefly the lack of explanation of and attention to fundamentals. The volume continues to cover a wide variety of conditions, although devoting only a few words to a moderately inclusive text on each condition. For the beginning medical student, a volume with less attention to comprehensiveness and with more attention to basic pathological processes would probably be more helpful. However, this reviewer agrees with the editor that if the teacher of pathology devotes the time and care in his lectures to the explanation of basic processes, then the book provides a valuable adjunct in a pathology course.

It is not necessary to assume that a textbook of pathology must be written in a single volume. There

are many places in this compendium that appear to have suffered severely because of lack of space—subjects that should be expanded into a second or third volume. This book therefore is at the crossroads. If it is expanded, it will become a two-volume edition. If further revisions are made downward, it will lose its inclusive nature and would then revert to a traditional textbook for medical students. It is felt that the authors should amplify their statements and expand into a second volume, perhaps dividing the book in the middle, with the first volume being devoted largely to principles and the second volume to the expansion of detail on unusual or rare subjects. The book is highly recommended for use by practicing physicians, pathologists, and medical students.

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Progress in Biophysics and Biophysical Chemistry, vol. III. J. A. V. Butler and J. T. Randall, Eds. Academic Press, New York, 1953. 386 pp. Illus. + plates. $9.50.

The new volume in this admirable series maintains, with few lapses, the high standards set by its predecessors. Several of the articles are of the nature of decennial reviews. Considering the chapters in order:

Doniach, Howard, and Pelc briefly, but authoritatively, summarize the physical principles, techniques, and principal accomplishments of the autoradiographic method. A set of excellent photographs clearly indicates the scope and power of the modern techniques.

Seeds provides a valuable summary of the rather limited data available upon the dichroism of the ultraviolet and visible absorption bands of oriented biological substances, with reference to the utility of such data in the determination of structure. With the development of microspectrographic methods, the potential range of application of this technique has been greatly expanded.

Fraser is concerned with the infrared spectra of biologically important molecules, particularly proteins, nucleic acids, and polysaccharides, and the assignments that have been made of the various bands. While the uncertainties of interpretation are indicated, the treatment is too brief to serve as much more than a guide to the literature.

Markham contributes a critical and authoritative review of several topics pertaining to viruses, including the use of centrifugal methods for virus purification and molecular weight determination, the study of the structure of virus crystals by electron microscopy and x-ray diffraction, and the investigation of the form of tobacco mosaic virus in solution by viscosimetric, birefringence, and light-scattering techniques. Markham's discussion clearly points out the inadequacies of some of the early work in this field and indicates some still unresolved discrepancies.

"Mechanism of biological action of ultraviolet and visible radiations" by Errera is a wide-ranging and quite complete review that is somewhat marred by an uncritical attitude and an awkward organization of material.

Booth gives a brief, but lucid, summary of the developments in the theory of the ionic double layer during the past decade and of the advances in the applications of this theory to a variety of specific problems, including among others, the stability of colloids, coacervation, and electrophoresis.

Davies and Walker provide a well-balanced and thorough review of the practices, potentialities, and difficulties (intrinsic and technical) of microspectrophotometry. The carefully reasoned discussion of the major contributions in this field is especially noteworthy.

Sadron's chapter is a critical review of the hydrodynamic and optical methods for determination of the size and shape of rigid macromolecules in solution. Particular attention is paid to the assumptions underlying the various methods, the internal consistency of the methods, and the necessity for consideration of the rigidity and degree of polydispersity of the particles. Experimental results upon TMV, serum albumin, and DNA are discussed as examples.

Teorell succinctly summarizes the theory of ionic transport across electrically charged (ionic) membranes. The applications of this theory to the development of membrane potentials, to the electric conductivity and reactance of such membranes, and to the establishment of transient and steady-state ionic distributions are discussed, with special reference to possible biological implications.

A disturbing number of typographical errors and faulty equation references must be noted.

The wide scope of topics in this volume forms an interesting contrast in conception of the nature of biophysics to that of the corresponding American series.

ROBERT L. SINSHEIMER

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Simuliidae of the Ethiopian Region. Paul Freeman and Botha de Meillon. British Museum (Natural History), London, 1953. vii + 224 pp. Illus. £2 10s.

The black flies constitute one of the most important families of bloodsucking Diptera, transmitting human onchocerciasis in Africa and Central America. A great annoyance wherever they occur, they often produce fatal toxemia by their mass attacks. The tropical African fauna has been studied in considerable detail, but this is the first revisionary work since the junior author's treatment of 23 species in 1930. This present work reduces the more than 100 described species to 69. This is the result of some complete synonymizing and some reduction of species based on pupal differences only to the status of forms. The authors discuss the species problem in some detail and suggest that these forms may actually be reproductively isolated, sibling species, a theory that seems

to have considerable support. These difficult species problems are found in the family throughout the world and are troublesome to solve because black flies do not lend themselves to laboratory colonization and experimentation.

The introductory portion contains good discussions of the life history, adult habits, zoogeography, relation to disease, anatomy of adult, pupa, and larva, and of the collection, preservation, and examination of material. This is followed by a taxonomic treatment of the species, which are arranged in the two genera *Cnephia* and *Simulium*. Characters are given for dividing the latter genus into two divisions, not named as subgenera, and these are again divided into seven species groups. The classification of the Simuliidae is still far from satisfactory, and there is great need for the coordination of the several systems that have been suggested for various faunas. The species are well described, and figures and keys are given to separate the females, males, and pupae. Distribution is given by country and, wherever known, there are notes on the larva and habits. This most welcome addition to our knowledge of the fauna of tropical Africa will be extremely useful in determining the species.

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Biology. Paul B. Weisz. McGraw-Hill, New York, 1954. 679 pp. Illus. $6.50.

The first 13 pages of *Biology* present the properties of life in broad outline against a background of the physical environment of the earth that furnishes the conditions where life is possible. Following this, at the "second level," 94 pages are devoted to a more intensive treatment of environmental relationships (soil and carbon and nitrogen cycles), composition of protoplasm (elements, compounds, ions, colloids, membranes, and osmosis), basic metabolic processes (catalysis, enzymes, photosynthesis, energy metabolism, and types of nutrition), and self-perpetuation (cellular and organismic regulation and reproduction, adaptation, sexuality, heredity, and evolution). The remaining 543 pages consider successively cell structure and function, differentiation and specialization, plant structure and function, skeletal and muscular physiology, community and social organization, photosynthesis and transpiration in plants, digestion and circulation in animals, respiration and energy metabolism, synthesis, vitamins, hormones, blood functions, excretion, circulatory mechanisms, nervous system and sense organs, reproduction (mitosis, growth, and gametogenesis), plant life-histories, human reproduction and its hormonal regulation, and genetics and evolution.

In returning to the same principles at successively higher levels of treatment, this book differs somewhat in plan from other biology textbooks. The author consciously tries to avoid methodical, compartmentalized handling of his material by integrating the main ideas of biology around processes rather than taxonomic groups or organ systems. Classification is relegated to six pages in the appendix. Only the briefest treatment is accorded to invertebrates, and even the comparative treatment of the lower vertebrate groups is only moderately developed. The emphasis is predominantly on human functions. The claim is made in the foreword that formal physics and chemistry are not necessary, that such physicochemical concepts as are needed are developed in the textbook itself. It may be questioned, however, whether the student with no previous chemistry can acquire from a few pages of simplified and condensed synopsis the necessary background for an adequate understanding of the role of pyruvic acid, adenosine triphosphate, and so forth, in energy metabolism. Weisz thinks that it is possible and makes a courageous attempt to give the student an insight into the chemical workings of the enzymes in cell metabolism.

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Introduction to a Study of Mechanical Vibration. G. W. Van Santen. Philip's Technical Library, Eindhoven, Holland; U.S. Dist., Elsevier Press, Houston, Texas, 1953. 296 pp. Illus.

The preface of this book states, "The object . . . is to review the elementary theory of Mechanical Vibrations, as well as some of the more important problems of vibration encountered in practice. . . . Every effort has been made to present each individual subject so as to demonstrate the essentials of the problems and thus provide a jumping off point for a special study of any particular branch of the work. At the same time we have tried in each instance to indicate practical lines for the direct solution of many problems."

To fulfill this object, the author has chapters in the usual order on definitions and free and forced vibrations. These are followed by chapters on electromechanical analogies, coupling between two and three mass systems, and simple isolation. Vibrational waves are studied to introduce the subject of sound isolation and control, and there are brief discussions of associated topics ranging from ultrasonics to seismology. Lateral critical speeds in shafts are briefly covered from the engineering point of view, since only the first critical speed is considered. Tangential effort diagrams and Holzer tables are outlined in the section on torsional vibrations. This is followed by a brief discussion of balancing, damping, self-excited vibrations, fatigue in materials, and human reactions to vibrations.

Three chapters are used to survey the general field of vibration measurement, with emphasis on vibration equipment manufactured by N. V. Philips, Eindhoven, Holland. The last chapter is a short but well-illustrated and interesting discussion of the human ear. Three short appendixes give common trigonometric formulas, complex quantities, and phase deter-

mination from a Lissajous figure. The table of symbols furnished shows only minor variations from nomenclature common in this country. The index appears to be complete. It should be noted that all units are in the cgs system.

The author has achieved his objective in a workman-like manner, considering the space used, 296 pages. The discussions are clear, the numerous diagrams are well executed, and the mathematics used is well within the grasp of anyone who has had a college course in calculus.

For the engineer or plant executive who wishes to gain familiarity with the general field of vibrations, this is an excellent first book. For the serious worker in the field or for the prospective teacher of a college-level course in vibrations, the treatment would have to be amplified by material from other sources, since much of the treatment is descriptive rather than analytic. In general, it is a review of many aspects of the field rather than a textbook on the subject.

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Condensed Pyridazine and Pyrazine Rings. Cinnolines, Phthalazines, and Quinoxalines. J. C. E. Simpson. Interscience, New York–London, 1953. xvi + 394 pp. Illus. $12.50.

The advancement of science is highly dependent on the accurate classification of scientific data. Accordingly, much appreciation should be felt for the accomplishments of those who labor at the often unrewarding task of gathering and classifying chemical knowledge.

This book is the fifth volume published in a series of monographs devoted to the field of heterocylic chemistry. It is indeed lamentable that the capable author of this work passed away before publication time. Simpson died on 7 Feb. 1952, at a time when his manuscript was being set in type.

Dealing with the chemistry of condensed pyridazine and pyrazine rings, the subject matter of the book is divided into three distinct parts: cinnolines, phthalazines (both formed by fusion of pyridazine and aromatic rings), and quinoxalines (formed by the fusion of pyrazine and aromatic rings). As stated by the author

> . . . this book has been written with the objective of ensuring continuity with, and expansion from, Meyer-Jacobson's *Lehrbuch der organischen Chemie*, Volume II, 3, and in order to avoid the creation of possible gaps the literature has been fully covered from 1917 up to the end of 1948. Adequate reference is also made to the 1949 literature, and in many instances details of compounds there described have been included in the tables.

In all, 9, 14, and 16 chapters are devoted to cinnolines, phthalazines, and quinoxalines, respectively. Where adequate information is to be found in the literature, the subject matter of each chapter is organized in sections devoted to methods of preparation, properties, and reactions. Much of the material is presented in convenient tables listing for each compound: preparation, melting point, general remarks of chemical and physical character, and references to the original literature. Appendixes give data on the ultraviolet absorption spectra, basic strengths, and antibacterial-parasiticidal activities of various compounds.

The text is well prepared and the binding is excellent. As a reference, the book should be welcomed by all who are interested in the complex and difficult field of heterocyclic organic chemistry.

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Annual Review of Nuclear Science, vol. 3. James G. Beckerley *et al.,* Eds. Annual Reviews, Stanford, Calif., 1953. 412 pp. Illus. $7.

Probably no one, certainly not the undersigned, can claim honestly and critically to review this book. The subjects of three full-page charts will make the reason clear: one shows the cross section for photoproduction of pi mesons from protons, over the whole energy range, including the quasi resonance at around 300 Mev; one, the time-scale for events in radiation chemistry, from the molecular transit of a fast primary electron to the reaction time of free radicals in water; and the third, the frequency of production of specific abnormalities in the development of mice, as a function of the amount and timing of the x-ray dose to the embryo. Nuclear science is broadly seen by the editors!

The editors and publishers deserve high praise for the production of such a volume of expert essays, with a good index and a set of more than 2000 references, in a time of only some 7 months between the latest citations and general availability of the book—moreover, one in serviceable letterpress typography.

One can group the 15 articles into three or four broad categories. Two authoritative articles, surprisingly up to date in such a volatile field, deal with "fundamental particle physics." Three Columbia experts present a succinct résumé of theory and experiment in the area of pion-nucleon interaction, and Leprince-Ringuet summarizes the situation of the "strange particles" of cosmic rays, as of late last summer (including the new nomenclature). Both of these pieces, particularly the first, can be highly recommended to students.

Three pieces concern themselves with nuclear physics of the more or less "classical" kind. Corson and Hanson review the interactions of photons and electrons, especially at energies from 10 or 20 Mev up. Hughes recounts the subtle and powerful technique of neutron optics and presents a useful up to date summary of coherent amplitudes for just about 100 nuclear targets. Wattenberg tells how neutron measurements have been made absolute, to a precision of about 4 percent.

There are articles on techniques of measurement in two distinct fields: one on the use of photographic emulsions in studying ionizing particles, and one on techniques of element separation in radiochemistry. The former, by Goldschmidt-Clermont, seems to carry much quantitative detail.

The last large category, about 40 percent of the book, deals with the relationships of nuclei and their radiations with more complex systems, from molecules to the bodies of men. One article (by Yankwich) discusses the effects of stable isotopes on the rate and equilibria of chemical reactions, emphasizing carbon and hydrogen. Two deal with radiation chemistry proper; one of these, by Magee, forms an excellent introduction to the general mechanisms involved, while the other, by Willard, is more specifically experimental and summarizes hot-atom chemistry at a more detailed level. Marinelli has a gem of a short piece on dosimetry, pinned to the present physical unit of dose, the erg/gram. Four pieces are devoted to radiobiology, and include a detailed résumé of results concerning the effects of various radiations on the cellular level, on the embryos of vertebrates from fish to man, on specific vertebrate tissues, including the generation of tumors, and last, an unforgettable piece by Hempelmann and Hoffman called rather ironically "Practical aspects of radiation injury."

In this last, the authors dryly and aseptically detail mainly the acute effects of radiation on mankind. Here one can read of the cataracts and the leukemia that followed the Japanese wartime epidemic of fatal radiation injury and of the poor microcephalic children exposed to the bombs *in utero*. The severe hand burns from some 10,000 roentgens to the skin from fission-fragment beta decays, received by five men in tests in Eniwetok, are described. Late effects are discussed, although not much is said about long-time low-level exposure. Workers with radiation ought to read this chapter, to understand the need for precautions. Indeed, since most of the data have been found by study of the victims of deliberate or accidental chain reactions, the chapter is worth study by every technically trained city-dweller, nuclear physicist or not. The table of doses to reactor victims will repay imaginative reading. Perhaps it will help translate the 75 disintegrations per second per milligram counted in sodium from the blood serum of case 3 if a few words remind the reader that this disintegration of the living blood is two orders of magnitude faster than that of the hottest sodium samples made with the usual laboratory radium source. It may help make clear the wider meaning of nuclear science in our times if I go on to say what the authors leave out: that the warm dark red radioactive sample, drawn from the veins of a man who was outwardly robust yet already swiftly dying, was that of my friend and colleague, the gentle, skillful physicist, Louis Slotin. He remains so far the last man on earth to have died from acute radiation injury.

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New Books

Radiation Biology. vol. I, *High Energy Radiation*, pts. I and II. Alexander Hollaender, Ed. McGraw-Hill, New York–London, 1954. ix + 1265 pp. Illus. $17.50.

College Textbook of Physics. Arthur L. Kimball. Rev. by Alan T. Waterman. Holt, New York, ed. 6, 1954. xii + 942 pp. Illus. $7.95.

The Compleat Strategyst. Being a primer on the theory of games of strategy. J. D. Williams. McGraw-Hill, New York–London, 1954. xiii + 234 pp. Illus. $4.75.

Geography of North America. George J. Miller, Almon E. Parkins, and Bert Hudgins. Wiley, New York and Chapman & Hall, London, ed. 3, 1954. xi + 664 pp. Illus. $7.50.

New Biology, No. 16. M. L. Johnson, Michael Abercrombie, and G. E. Fogg, Eds. Penguin Books, Baltimore, 1954. 135 pp. Illus. + plates. Paper, $0.50.

Wave Motion and Vibration Theory. Proc. of Symposium in Applied Mathematics of the American Mathematical Society. vol. V. Albert E. Heins, Ed. McGraw-Hill, New York–London, 1954. v + 169 pp. Illus. $7.

Aerodynamics. Selected topics in the light of their historical development. Theodore von Karman. Cornell Univ. Press, Ithaca, N.Y., 1954. ix + 203 pp. Illus. $4.75.

Physics of Experimental Method. H. J. J. Braddick. Wiley, New York, 1954. xx + 404 pp. Illus. $7.

Representative Chordates. A manual of comparative anatomy. Charles K. Weichert. McGraw-Hill, New York–London, 1954. vii + 204 pp. Illus. $3.50.

Ethics. P. H. Nowell-Smith. Penguin Books, Baltimore, 1954. 324 pp. Paper, $0.85.

Vegetable Tanning Materials. F. N. Howes. Chronica Botanica, Waltham, Mass.; Butterworths, London, 1953. xi + 325 pp. Illus. $5.50.

Science and the Common Understanding. J. Robert Oppenheimer. Simon and Schuster, New York, 1954. 120 pp. $2.75.

Economic Geography. Clarence Fielden Jones and Gordon Gerald Darkenwald. Macmillan, New York, rev. ed., 1954. xxv + 612 pp. Illus. $6.75.

The Foundations of Statistics. Leonard J. Savage. Wiley, New York; Chapman & Hall, London, 1954. xv + 294 pp. $6.

Introduction to Psychiatry. O. Spurgeon English and Stuart M. Finch. Norton, New York, 1954. viii + 621 pp. $7.

Dictionary of European History. William S. Roeder, Ed. Philosophical Library, New York, 1954. viii + 316 pp. $6.

Endemic Goiter. The adaptation of man to iodine deficiency. John B. Stanbury *et al.* Harvard Univ. Press, Cambridge, 1954. xii + 209 pp. Illus. $4.

Dreams and Nightmares. J. A. Hadfield. Penguin Books, Baltimore, 1954. xi + 244 pp. Paper, $0.65.

Molecular Theory of Gases and Liquids. Joseph O. Hirschfelder, Charles F. Curtiss, and R. Byron Bird. Wiley, New York; Chapman & Hall, London, 1954. xxvi + 1219 pp. Illus. $20.

The Judgment of History. Marie Collins Swabey. Philosophical Library, New York, 1954. x + 257 pp. $3.75.

Industrial Stoichiometry. Chemical calculations of manufacturing processes. Warren K. Lewis, Arthur H. Radasch, and H. Clay Lewis. McGraw-Hill, New York–London, ed. 2, 1954. xi + 429 pp. Illus. $7.50.

George Davidson: Pioneer West Coast Scientist. Oscar Lewis. Univ. of California Press, Berkeley; Cambridge Univ. Press, London, 1954. viii + 146 pp. + plates. $3.50.

Technical Papers

Fluorescence as a Means of Identifying Smog Markings on Plants

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Smog attacks are generally characterized by reduced visibility, eye irritation, and the marking of leaves of various plants. According to an article published in 1950 by Middleton *et al.* (*1*), it was recognized as early as 1944 that certain leaf markings observed in and around Los Angeles were the result of pollutants in the atmosphere. This article included the first description of the markings and stated that they were found throughout the Los Angeles Basin. More recently, Middleton *et al.* (*2*) indicated that the economic loss in leafy crops exceeded $500,000 yearly and that the area of damage was expanding. Similar markings have been found in the San Francisco Bay area (*2, 3*).

For about 2 yr, beginning in June 1951, a plant pathologist of the Stanford Research Institute staff continuously observed commercial vegetable fields and ornamental plants in the Los Angeles area and compared markings that appeared on them with those that developed on similar plants grown in greenhouses receiving cleansed and uncleansed air. It became apparent that, in addition to the commonly recognized smog markings, there were others that were commonly observed that could not be distinguished readily from markings caused by other factors: insects, poor cultural practices such as under- and overfertilization, flooding, and so forth. This ambiguity, as well as increases in economic loss and in the extent of the area affected, emphasized the desirability of an objective means of distinguishing between markings resulting from smog and those caused by other factors.

Following a smog attack in Menlo Park in 1953, it was discovered that the so-called "typical" smog markings that occurred on the leaves of *Chenopodium murale* and *Malva porviflora* fluoresced pale blue when irradiated with near ultraviolet light from a mercury vapor lamp. The unmarked portions of the leaves did not show this fluorescence.

In a review of the literature on fluorescence of vegetation (*4*), no mention was found of pale blue fluorescence of leaves under ultraviolet light. It seemed, therefore, that this property might provide, at least in part, an objective method of differentiation. To test this, leaves of a wide variety of plants, both unmarked and marked by several factors, were examined under ultraviolet radiation.

The source of the radiation was a spherical Bausch & Lomb microscope illuminator in which the socket was replaced by one that would take a GE BH4 100-w ultraviolet bulb, connected with the special transformer needed for its operation. The radiation was directed at the leaves from an angle, so that they could be observed under a microscope if desired. Five minutes in a dark room was allowed for the source to warm up and the eyes to become adjusted.

Smog-marked leaves of many weeds and leafy vegetables, gathered in Los Angeles, were wrapped in aluminum foil and shipped to Menlo Park, where they were examined the next day. These leaves, showing the visible smog markings, also showed the fluorescence. The marked areas appeared as sharply defined bright pale blue. Under visible light, their color showed little relationship to the fluorescent color; that is, silver, brown, and tan areas all fluoresced pale blue. As the leaves dried out for a day or so in air, the intensity of the fluorescence increased markedly. Leaves were therefore examined as soon as possible after collection and again a day or so later.

To determine whether unmarked leaves or leaves marked owing to nutrient deficiencies, insects, or insecticides also showed the fluorescence, a wide variety of economic, ornamental, and weedy plants were examined. None of these showed typical smog-induced fluorescence. Pubescence caused leaves to exhibit a dim background fluorescence quite different from that of smog-marked leaves. Specialized cells along the midrib of certain grasses also glow in ultraviolet radiation.

Fungus hyphae and insect deposits were found to fluoresce blue. It is therefore important to examine leaves microscopically with visible light.

As a further test, plants of spinach, romaine, endive, and sugar beets, and some weeds such as *Poa annua* and *C. murale*, were fumigated with mixtures of ozone and hexene, ozone and gasoline vapors, and ozone and auto-exhaust gases for sufficient time to produce leaf markings, using procedures similar to those of Haagen-Smit *et al.* (*5*). Previous work had shown that such fumigations would produce leaf markings similar to those produced by smog. The markings produced in these experiments fluoresced similarly to those produced by smog. However, the results were not very consistent, and further study is indicated.

To examine the effect of other possible air contaminants, markings were produced on vegetation by fumigation with HF, SO_2, H_2S, Cl_2, oxides of nitrogen, SO_3 and O_3. The methods used were generally taken from Thomas' review article (*6*). None of these markings fluoresced. However, care had to be taken not to confuse smog markings with pure white markings, produced at times with SO_2 and Cl_2, which readily reflect light and almost appear to fluoresce under ultraviolet. This is also true of the spotty, white, granular injury produced by SO_3.

As a final test of the fluorescence method, one of us collected about 40 samples of leaves in Los Angeles. These were classified as definitely marked by smog, questionably marked by smog, marked by some other factor, and unmarked. They were numbered, wrapped in aluminum foil, and sent to Menlo Park for examination. Without knowing what the markings had been

ascribed to, another one of us examined the leaves under ultraviolet radiation. Of 11 samples classified in the field as definitely showing smog markings, all exhibited the fluorescence after drying for a day. These markings included silvering on spinach and nettleleaf goosefoot, bronzing on romaine, lower-surface injury on beets, and white markings on *P. annua*. Of nine samples classed as having light smog damage, six fluoresced after drying for a day. Those that did not fluoresce may not have been damaged enough to cause extensive cell collapse (an apparent requisite for fluorescence). Nine samples were classified as having questionable smog markings. Six of these showed some fluorescence. The remaining samples were either not marked or were marked by some factor other than smog. Most of them showed no fluorescence at all, and the others showed either mild background fluorescence or the types produced by mildew and insects.

The reason for the development of the fluorescence of these leaf markings is not known, but it may be related to the "browning reaction" (*7*). In this reaction, a bright blue fluorescence in ultraviolet light develops in foods before the formation of the characteristic dark brown color.

In summary, the leaf markings that result from smog, and are the cause of extensive economic loss, appear to fluoresce distinctively under ultraviolet radiation. This observation has been checked by comparing the response to ultraviolet radiation of sensitive plants exposed to actual smog, to synthetic atmospheres, and to a variety of cultural conditions.

If further work confirms the results of these studies, the bright pale blue fluorescence of smog-marked leaves will provide the first objective means of assessing the responsibility of smog for vegetation damage.

References and Notes

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14 June 1954.

Desert Varnish

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Desert varnish is a blackish or brownish stain of iron and manganese oxides on rock surfaces. As the name implies, desert varnish is best developed, or at least most conspicuous, in arid or semiarid regions; but similar staining also occurs in humid regions—in northeastern United States, in tropical rain forests, at high altitudes in the Alps (*1*), and on tunnel walls in the southeastern United States. Glacial and periglacial boulders at alpine levels in the Rocky Mountains commonly are stained.

The stain occurs on nearly all kinds of rocks—glassy, volcanic, and granular plutonic rocks ranging in composition from granitic to basaltic, sandstone, dense chert, and, more rarely, bull quartz. It is less common on limestone than on the less calcareous rocks.

The varnish may coat isolated bodies or the exposed and now dry surfaces of pebbles or cobbles forming a desert pavement. It may coat vertical or overhanging cliffs, or rock surfaces that are splashed by rivers or wetted by springs or seeps. It may develop on surfaces that are dark or poorly lighted, such as tunnel walls or joint planes. The coatings on joint surfaces or other slightly opened planes of parting in the rocks grade into vein deposits.

Although the stain appears to be composed largely of iron and manganese oxides, the proportions of these must vary greatly from place to place. Certainly the color and luster vary, although they are controlled in part by the fineness of the grain of the rock that is coated and in part by wind polish.

Such widespread deposits in such heterogeneous environments assuredly have heterogeneous origins. At some places, the stain appears to have been transported a considerable distance to the surface that is coated; at other places the coating seems to have been derived from weathering of minerals in the rock beneath it. Some stain assuredly was deposited by physical-chemical processes, but other staining appears to have been deposited biochemically. Either process, however, requires active moisture. In southwestern United States, the desert varnish seems to be in large part the product of past pluvial climates.

The conspicuous deposits of desert varnish on the Colorado Plateaus today are being eroded. On the cliffs, the varnish is preserved on smooth flat cliff faces or beneath overhanging ledges, but it has been largely removed from the rounded edges of joint blocks and from the more exposed upward-facing parts of the sandstone cliffs or buttes. Recent rock falls from the cliffs leave bright scars on surfaces otherwise darkened with varnish. Varnish still coats protected parts of isolated boulders, but it has been removed from their weathered rounded edges. Moreover, the conspicuous and extensive deposits are associated with a topographic unconformity that reflects a past climatic change. It seems clear that the conspicuous deposits of varnish in the Colorado Plateaus have a respectable antiquity and are the product of a past epoch.

The deposits of varnish that are forming today are restricted to places that are wetted frequently. Boulders lying between the high- and low-water stages of the Colorado River, for example, are stained; so are the sandstone cliffs where they are moistened by seeps. Such deposits suggest that the moisture requirements for deposition of desert varnish are considerable.

Archeological evidence indicates that the principal deposits of varnish on the Colorado Plateaus were formed prior to introduction of pottery. The masonry dwellings of the pottery-making Anasazai and related

peoples are stained but little. Their petroglyphs were pecked into deeply stained rock surfaces, but the pecked figures, for the most part, remain fresh.

Locally, however, two generations of petroglyphs occur on the same cliff face, and the older may be stained. In southeastern Utah, the older set of petroglyphs commonly includes the square-shouldered conventionalized human figure of geometric outline that is believed to date from pre-pottery or earliest pottery times (*2, 3*).

At such places, the exact dates remain uncertain, but the chronology is clear. First, there occurred extensive deposition of desert varnish, and this predated an occupation that may predate pottery. This occupation was followed by deposition of more varnish, and this deposition was followed by the occupation known as Developmental Pueblo—A.D. 500 to 900.

The younger varnish that formed during the interval between the occupations was deposited about the same time as one of the alluvial formations in the Colorado Plateaus. Presumably this was a pluvial period more or less at the beginning of the Christian Era. The older varnish may be as old as late Wisconsin in age.

It is suggested, therefore, that the principal deposits of varnish on the Colorado Plateaus were formed during the wet periods, and as such they can be useful in deciphering the stratigraphy of late Pleistocene and Recent deposits and events.

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22 March 1954.

Growth, Food Utilization, and Thyroid Activity in the Albino Rat as a Function of Extra Handling

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In an earlier paper (*1*) we reported, as has Weininger (*2*) more recently, that albino rats that were given extra handling by the experimenter showed significantly greater weight gains than animals that were unhandled or were handled only for routine experimental procedures. From the findings of these earlier studies, it could not be determined whether the differences in weight gains were due to better physiological use of the food consumed or to greater quantities of food consumed. The present study, suggested by Benjamin, is one of a series of attempts to resolve this question and to make preliminary explorations into the mechanisms whereby these physiological differences are mediated.

In our first experiment, 42 weanling male albino rats of the Denver University strain were obtained in nine litters. Using a table of random numbers, the animals were assigned to an extrahandled and an unhandled group in such a manner that both groups had the same number of rats from any one litter. The animals were housed in individual cages with wire mesh bottoms and sides. Purina food pellets and water were supplied *ad libitum*, and equal quantities of fresh lettuce and vitamin supplements were given each rat once each week. To minimize any temperature or environmental differences between the location of the cages on the rack, both the cages and the rack were rotated once each week. The extrahandled animals were removed from their cages for a period of 10 min each day and were individually petted. The unhandled animals were never touched during this period. Semiweekly records were kept of the animals' growth, food consumption, water consumption, fecal pellet excretion, and general state of activity.

At the end of the 5-wk experimental period, the animals were injected intraperitoneally with 50 μc of I^{131} and 24 hr later were sacrificed with chloroform anesthesia. Each rat was suspended from a ringstand by its tail, and a measurement was made from the tip of the nose to the anus for carcass length. The thyroids were removed intact and still fastened to a very small portion of trachea, for radioactive assay. Various organs, such as the liver, kidney, and spleen, were wet weighed, and finally, the whole carcass, except for the tail, was ground in a meat grinder until a homogeneous sample resulted. Samples of these whole carcasses were then weighed carefully and assayed for moisture, fat, and protein.

Our data indicate that there was no statistical significance between the amounts of food eaten by the two groups; nevertheless, the animals in the extrahandled group showed a mean weight gain of 122.8 g compared with 108.1 g for animals in the unhandled group, a difference significant at the .001 level of confidence, and substantiating our findings in previous pilot studies. The ratio of grams food consumed per gram weight gain averaged 4.82 for the extrahandled animals and 5.49 for the unhandled, the difference being significant at the .001 level of confidence.

It appears, then, that we have evidence of better growth and utilization of food by the extrahandled animals. Growth, in this instance, bears the connotation of greater over-all increase in carcass weight, including a larger skeleton. Carcass analysis indicated that both groups of animals exhibited approximately the same percentages of fat and moisture on a 100 g of body weight basis and that the extrahandled rats had, indeed, grown more than the unhandled animals. No significant differences were observed between the weights of kidneys, livers, or spleens.

In addition to the grams of food per gram weight gain ratio, there is other evidence of superior food utilization by the extrahandled animals. The unhandled animals excreted a mean of 3017 fecal pellets, while the extrahandled animals excreted a mean of

2705 pellets, a difference significant at the .001 level of confidence. The ratio of number of fecal pellets per gram of food consumed gives a similarly significant difference.

It was daily observed that the extrahandled animals exhibited much more activity and curiosity than the unhandled group. The extrahandled animals spent more time scampering about their cages and watching other activity going on. The unhandled animals generally sat in one position for long periods of time, often facing a corner of the cage.

In our second experiment, 36 male weanling animals of the Sprague-Dawley strain were distributed at random from previously weight-segregated groups; consequently, the average initial weight in each group was the same. Using Sprague-Dawley rats should indicate whether or not a species difference in reactivity exists and whether or not it is possible to obtain the same physiological differences with rats that are not necessarily litter mates. In general, our findings substantiated those in our first experiment, with one exception: the unhandled animals of the Denver University strain drank significantly more water than the extrahandled animals of the same strain. We were unable to repeat this finding with Sprague-Dawley rats in our second and third experiments.

In a third experiment, 48 male Sprague-Dawley weanling rats were randomly divided into four groups: a handled group, individually caged; a handled group, with three animals to a cage; an unhandled group, individually caged; and an unhandled group, with three animals to a cage. The size of the cages of the grouped animals was approximately 3 times that of the individual cages. Again, our data indicate that the findings in our first experiment can be substantially repeated, whether the animals are individually caged or caged in groups. A direct comparison between the extrahandled animals caged individually and those caged in groups of three is not possible at this time, since two investigators were involved.

The increased growth and better utilization of food observed for the extrahandled animals indicated a possible difference in the thyroid activity of these two groups. It is fairly obvious that our findings cannot be a function of differences in the amount of exercise received, since the unhandled animals were much less active and should, by this reasoning, have gained more weight. Our data (Table 1) show that in all three of our experiments, the thyroids of the unhandled animals were in a more active state than those of the extrahandled animals, as indicated by the differences in percentages dose uptake of I^{131} ($P = .001$). This increased thyroid activity on the part of the unhandled animals, whether or not it is a function of differences in anxiety level, may well be an important mediating factor in the production of the observed differences in growth and food utilization. Comparable studies of other endocrine functions are indicated for further clarification of the psychophysiological relationships involved.

Table 1. Comparison of the thyroid activities of extrahandled and unhandled laboratory rats. Two investigators (A and B) performed the experiments with handled (H) and unhandled (U) rats.

	No. animals per group	Avg. percentage dose I^{131} taken up by thyroids			
		A-H	A-U	B-H	B-U
Test 1	10	3.48	3.93	3.21	3.94
Test 2	12			3.20	3.51
Test 3	12	2.60	3.80	2.97*	3.32*

* The animals in these tests were housed three animals to a cage.

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* Now at Veterans Administration Hospital, Syracuse, New York.
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24 March 1954.

Occurrence of Both Caoutchouc and Gutta in Additional Plants

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Since it was reported that chicle (the resinous exudate of *Sapota achras*) contains both caoutchouc and gutta (*1, 2*), the question has been raised whether other plants also produce both cis- and trans-polyisoprene. Examination of samples of about 50 coagulated latexes from other lactiferous trees has revealed several other examples of the presence of both of these polymers. They are shown in Table 1, together with other pertinent data on the samples.

The procedures used in the analysis were similar to those previously reported for the separation of caoutchouc and gutta from chicle (*2*). A 10- to 15-g sample of the coagulated latex was dried at 60°C under vacuum. The dried sample was weighed into a tared extraction thimble and extracted in a Soxhlet extractor with reagent-grade acetone for 48 hr. The thimble was then dried at 60°C under vacuum, usually overnight, and reweighed. From the loss in weight, the percentage of acetone solubles was calculated.

The dried, extracted, acetone-insoluble residue, together with portions of the extraction thimble adhering to it, was suspended in 40 ml of benzene and allowed to stand at approximately 25°C for 48 hr. It was then heated to 35°C for a few minutes and centrifuged. The clear supernatant was decanted; 80 ml of ethyl acetate was added to it, and the mixture was allowed to crystallize overnight in the refrigerator at 5° to 10°C. Gutta separated as a white or off-white precipitate. It was filtered, air-dried, and weighed. The yield of gutta was calculated from this figure.

To the benzene-ethyl acetate filtrate from the pre-

Table 1. Analysis of several resinous exudates.

Native designation	Region from which obtained	Botanical designation	Acetone soluble*	Acetone insoluble*	Caoutchouc*	Gutta*
Chakun	Bang-bao (Siam)	*Mimusops* sp.	77.6	22.4	0.59	13.7
Chakun	Bang-bao (Siam)	*Mimusops* sp.	71.9	28.1	.25	16.9
Chakao	Tapet (Siam)	*Palaquium* sp.	66.4	33.6	.70	10.6
Chikhao	Thapet (Siam)	*Palaquium* sp.	73.4	26.6	.23	10.4
Masang	Huay-rai (Siam)	*Mimusops* sp.	76.2	23.8	.02	15.7
	Huay-rai (Siam)		72.6	27.4	.09	16.7
	Prae (Siam)		74.6	25.4	.52	18.1
Khanun-nok	Khlung (Siam)	*Palaquium obovatum*	75.9	24.1	1.30	6.4
	Khlung (Siam)		68.0	32.0	3.7	20.9
	Traat (Siam)		65.1	34.9	4.5	21.5
White Nato	Davao Penal Colony, P. I.	*Palaquium* sp.	54.9	45.1	1.9	41.8
Red Nato	Davao Penal Colony, P. I.	*Palaquium* sp.	56.0	44.0	3.6	41.5
Malak-malak	Macum, Tagum Davao, P. I.	*Palaquium philippense*	63.4	36.6	2.0	18.5
Kalipayia Colorado	La Brea, P. I.	*Palaquium ahernianum*	55.1	44.9	1.5	31.9
Kalipayia Blanca	La Brea, P. I.	*Palaquium ahernianum* Merrill	61.1	38.9	6.6	17.5
Lokosdulian	Lituban, P. I.	*Palaquium* sp.	56.8	43.2	1.5	32.4

* Percentage of dried coagulated latex obtained from the plant.

cipitation of the gutta was added dropwise, with stirring, an equal volume of methanol (120 ml) containing a trace of sodium iodide. After standing overnight, the sticky mass of caoutchouc was separated by decantation or filtration, whichever was more practical. The caoutchouc was dried under vacuum at 60°C and weighed. The yield was calculated from this weight.

The data presented show that chicle is not a unique plant exudate in having both cis- and trans-polyisoprene (caoutchouc and gutta). Several species of the genera *Palaquium* and *Mimusops* were found to yield latexes containing both hydrocarbons.

The authors' thanks and appreciation are due to Llewellyn Williams of the L. A. Dreyfus Company, Oak Tree, N.J., for collecting and transmitting the samples, and to the Wm. Wrigley Jr. Company for permission to publish these data.

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12 March 1954.

Communications

Duration of Infectivity of the Virus of Silkworm Jaundice

Insect viruses contained within polyhedral inclusions are known to be remarkably resistant to the effects of drying and other adverse environmental conditions. In the literature, such viruses have been variously reported as viable for "months," "years," "several years," and so forth. Bolle, in 1907 [*Z. landwirtsch. Versuchsw. Deut. Oesterr.* **10**, 233], made the rather cryptic statement: "Es verdient hier die konstatierte Tatsache besonders hervorgehoben zu werden, dass nämlich das Infektionsvermögen der polyedrischen Körnchen selbtst bei über 25 Jahre altem Infektionsmaterial unverändert erhalten wird." Recently I had the opportunity to test experimentally the infective capacity of a lot of silkworm-jaundice virus (*Borrelina bombycis* Paillot) stored for a period of 15 yr.

In 1948, through the kindness of N. R. Stoll, I obtained a number of flame-sealed glass tubes of the silkworm-jaundice virus that had been prepared in 1939 by the late R. W. Glaser of the Rockefeller Institute for Medical Research. The tubes were filled with polyhedra-containing hemolymph, and have been stored at room (23°C) and refrigerator (4°C) temperatures, mostly the latter.

On 8 Sept. 1953, the contents of one of the tubes was fed on mulberry leaves to healthy silkworm larvae [*Bombyx mori* (Linn.)]. Within 5 to 7 days, two of the three test larvae died with typical jaundice symptoms, and large numbers of polyhedra were observed in their body contents. A control group of at least 100 silkworms remained healthy.

Again, on 30 Apr. 1954, silkworm larvae were fed mulberry leaves contaminated with suspensions of polyhedra drawn from diseased silkworms 15 yr previously. Twenty-five of the 30 test larvae succumbed with symptoms typical of silkworm jaundice. None of the 25 control larvae showed any signs of infection.

Furthermore, the polyhedrosis has never appeared spontaneously in our stock. The latter was obtained through the courtesy of G. H. Bergold in June 1953.

Thus it would appear that the virus of silkworm jaundice is capable of retaining its infective capacity while stored in sealed tubes (mostly at 4°C refrigeration) for a period of at least 15 yr.

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27 May 1954.

A Theory to Account for the Effects of Early Handling on Viability of the Albino Rat

Weininger (*1*) found that early handling of the male albino rat results in greater weight, increased skeletal length, and reduced cardiovascular and gastrointestinal damage under severe emotional stress as an adult. Ruegamer *et al.* (*2*) have shown this gain in weight by extra handling to be a result of better food utilization by the rat rather than of increased food consumption.

A major change in hypothalamic functioning, involving reduction or inhibition of massive sympathetic discharge in response to an alarming stimulus and, hence, decreased ACTH output from the pituitary, is suggested (*3*) to account for the afore-mentioned results. Such a reduction in ACTH output could account for the adrenal hypoactivity (*1*) obtained under emotional stress in handled animals and, hence, for the reduction in damage to the heart and stomach of these animals compared with controls.

Such a reduction in posterior hypothalamic reaction to alarming stimuli might also, in the long run, account for the greater skeletal length and weight of the gentled rats. Fried (*4*) has found in clinical studies of children that socioemotional disturbances have a direct and adverse effect on physical growth. Thus the same stimuli in the laboratory routine may have had more of an emotionally disturbing and growth-inhibiting effect on the nongentled rats. That this is the case is certainly suggested by their greater fearfulness both in an open field (*1*) and in their home cages (*2*).

Production of somatotrophic hormone in these animals may have been reduced concomitant with a higher level of ACTH production from the pituitary, arising in turn from a higher level of emotional reactivity. An inverse relationship of STH production to ACTH production under systemic stress is suggested by Selye (*5*).

Early handling would thus appear to have induced a permanent rise in the threshold for emotional reactivity. To test this hypothesis, the peripheral autonomic response of gentled rats to a mildly alarming stimulus, in terms of changes in electrical skin resistance, tail temperature, and blood pressure, could be compared with that of nongentled controls.

Such a change in the threshold of emotional reactivity of gentled animals may have taken place through an alteration in the cortical-diencephalic relationship, particularly through increased cortical inhibition of the posterior hypothalamus. Since, as is well known, removal of the cortex or depression of cortical function, as in anoxia, increases emotional reactivity in experimental animals (*6*), it can be presumed that a general increase in the level of cortical activity of gentled rats and, thus, an increase in cortical stimulation of the posterior hypothalamus may be involved in the decreased emotional reactivity of these animals. This proposition could be readily tested by comparing electroencephalographic records of cortical activity of gentled rats with records for suitable nongentled controls.

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14 June 1954.

A Method for Marking Marine Worms

The need of a suitable method for marking or tagging polychaetous annelids was stressed by A. H. Gustafson [*Dept. Sea Shore, Research Bull.* 9, 1 (1953), Augusta, Me.]. However, none of several methods he employed proved to be satisfactory. When I undertook studies on the natural population of the marine polychaetous annelid *Glycera dibranchiata* Ehlers in the area of Wedgeport, Yarmouth County, Nova Scotia, a search was made for a suitable marking method.

After several experiments with a number of biological stains, such as methylene blue, Sudan III, alizarin red, and Bismarck brown vital, I found that only Bismarck brown stained subjects for any considerable length of time. Worms immersed for 1 to 2 hr in 1/1000 and 1/2000 concentrations of Bismarck brown in sea water took up some stain. They were afterward kept for several days in dishes of sea water, which was changed daily. However, the color faded slowly, and after 14 days practically all coloring was gone, so that the subjects could not readily be distinguished from control worms. About 50 marked worms were released into the mud of the intertidal zone, and after 48 hr they could not be distinguished by color from unmarked individuals. It was concluded that this method could be of limited use only, and an effort was made to find a more permanent method of marking.

When silver nitrate was applied to the surface of *G. dibranchiata*, it stained the area on which it was applied dark brown. Several laboratory experiments gave promising results. Field tests showed that worms marked by silver nitrate and released were still marked when recovered after 30 days.

Worms of 4 to about 30 cm in length were marked with silver nitrate in the form of a commercial "caustic pencil," composed of silver nitrate 40 percent and potassium nitrate 60 percent. When a worm was touched with the caustic pencil, a whitish mark appeared at the place of contact. This was due to the formation of silver chloride. At the same time it was observed that the segments on which the whitish mark was visible temporarily contracted. After some time, the whitish mark turned dark brown.

By means of various combinations of dots produced by silver nitrate on the dorsal and the ventral surfaces, worms can be marked according to different groups. I employed this method to mark *G. dibranchiata* according to different size-classes.

From a few laboratory experiments with *Nereis virens* Sars, *Nephthys caeca* (Fabricius), and a few dead shells of *Mya arenaria* Linnaeus, it appears that the method can be extended successfully to the marking of many soft- and hard-bodied animals.

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13 April 1954.

Sorption of Carbon Dioxide by Nut Meats

During some packaging experiments with shelled walnuts and pecans in transparent, flexible plastic bags, packages in which the air had been displaced with carbon dioxide prior to sealing often developed sufficient vacuum to cause the package to collapse, drawing the film tightly around the contents in a manner similar to that of a package sealed under vacuum. The use of nitrogen instead of carbon dioxide did not produce this effect.

Data on the sorption of carbon dioxide by dried-milk powder were reported by J. A. Pearce [*Can. J. Research* **23**(F), 327 (1945)]. He found that whole-milk powder, at 35°F and approximately 74 cm of mercury, absorbed more than 0.4 ml of carbon dioxide per gram of milk powder. Under like conditions, only about 0.012 ml of nitrogen was absorbed. Pearce also showed that there is some sorption of carbon dioxide by skim-milk powder, although the rate and amount are less than those of whole milk. He concluded that carbon dioxide is sorbed not only by the butterfat but also by the other constituents of milk powder.

In tests at Beltsville, walnut meats (containing 68 percent oil) in a closed system absorbed 0.3 to 0.4 ml of carbon dioxide per gram during the first hour. Thereafter the rate was extremely low. Oil extracted from the nuts by pressure sorbed about 0.6 ml/g in ½ hr (with very gentle agitation of the oil), whereas the fat-free meats (walnuts that had been ground and solvent-extracted) sorbed only 0.17 ml/g in 24 hr. Oil that had been saturated with carbon dioxide and then held under vacuum for 15 min absorbed only about half as much of the gas as it did originally. This seems to indicate that vacuum alone does not completely degas the oil. However, when this oil was heated to 145°C and then cooled to room temperature, the carbon dioxide uptake was found to be approximately the same as that of the original sample.

It appears that the vacuum developed in packages of nut meats packed in an atmosphere of carbon dioxide is due chiefly to sorption of the gas by the oil in the nuts and to some slight amount of absorption by other nut constituents.

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14 May 1954.

Sagacity of a Crab

Seventy-seven years ago someone who was more sagacious than I presented observations under the title, "Sagacity of a lobster" [Anon., *Nature* **15**, 415 (1877)]. That observer's wariness was exhibited by the fact that he remained anonymous and by the fact that he used the word *sagacity* rather than *intelligence*, in which I shall imitate him here, since *intelligence* and even more precise terms such as *preference* have aroused considerable criticism when applied to lower animals. *Sagacity* has the advantage of less common usage and in one sense, especially formerly, it was used to indicate keenness of sensory perception without necessarily implying understanding. However, where one begins and the other ends is hard to say, and loosely the two words are considered to be synonyms.

Swimming crabs are given to swimming in dangerous situations, come enemies or not, as at the surface well sky-lighted for predators in the waters below. In shallow waters of the Gulf Coast, the blue crab, *Callinectes sapidus*, may be observed at the surface 5 mi from shore, valiantly fighting off attackers in a losing battle [G. Gunter, *Publ. Inst. Marine Sci.* **1** (2), 7 (1950)].

This habit of the blue crab led to an episode that I observed some 3 yr ago and upon which I have cogitated considerably since, with no answers. Since the actions of the crab in question seemed to approach what is commonly known as "intelligent," and since I am mindful of the various Horatios of behavior who would guard us well from mental connections with the lower animals, I have not heretofore had the temerity to record the observation. However, since the circumstance will be difficult or impossible to duplicate experimentally and may not be seen often again in nature, I now muster the courage.

One morning a half-grown blue crab was swimming at the surface with the incoming tide, alongside the dock and some 14 ft beneath my feet. The water was turbid. Suddenly a fish attacked from an angle below.

It was a sheephead, *Archosargus probatocephalus*, about 1 to $1\frac{1}{2}$ ft long. The crab by a deft maneuver was able to avoid the initial clumsy rush of the fish, which then found itself at the surface with no headway and with the crab poised over its tail fin. It turned clumsily first one way and then the other, but the crab turned similarly on the smaller circle and remained poised right over the tail fin. The fish turned circles and figure eights but the crab continued to hold its precarious vantage, with the dangerous head always pointed the wrong way for capture. Whether this veritable little dance of death went on for 5 sec or 25, I cannot say, since I was too intent upon watching and never thought of timing the contestants, but it did continue until the fish abandoned these tactics and swam out of sight in the murky water below. Then within a few seconds the same fish, or another just like it, attacked again from below, this time successfully and quickly vanished with the crab in its jaws. That, undoubtedly, was the end of the sagacious crab.

Several questions arise from this simple observation. The crab appeared to know that headlong horizontal flight away from the fish would place it immediately in a vulnerable position. At least it did not take such action. The crab also seemed to know that the head of the fish was dangerous, rather than the tail over which it swam, a point for which, incidentally, I would not have given a crab credit prior to this observation, and about which I still wonder. But if the crab did know, the question is how? It would seem that lessons on this point are usually fatal. We could fall back on instinct, but there are other enemies in these waters who can change ends much faster than any crab can maneuver, and a crab species with instinctual behavior attuned only to relatively clumsy sheepheads would not last long. I draw no conclusions, except that such behavior must have survival value, although it was unsuccessful in this instance, for any prolongation of life in time of great danger must ultimately result, in some instances at least, in a change of events permitting escape.

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17 May 1954.

Citation of Fraudulent Data

The occasion for these remarks is the recent treatment by some British scientists and historians of science of the claims made by Paul Kammerer.

Almost the entire story of the Kammerer affair can be found in the back volumes of *Nature*. Kammerer was a Viennese zoologist who published a number of papers, later summarized in a book (*1*), in which he claimed to have proved that acquired characters were inherited. He based his claims chiefly on two series of experiments. He stated first that the black viviparous Alpine salamander (*Salamandra maculosa*) and the black and spotted oviparous lowland salamander (*forma taeniata*) could each be made to acquire the characters of the other. The second series of experiments was made with the midwife toad (*Alytes obstetricans*), the male of which lacks the pigmented thick thumb pads that some other toads possess. Kammerer claimed that, as a result of his experiments, the male of this species could be made to inherit thumb pads.

These claims were challenged by William Bateson as early as 1919, and a very acrimonious debate ensued (*2*). Kammerer replied (*3*) to Bateson's attacks, and he was defended vigorously by E. W. MacBride (*4*). The controversy developed into a most interesting chase. Bateson wished to examine Kammerer's preserved specimens but could not; no matter where he went, Kammerer managed to be elsewhere. Bateson never caught Kammerer, but the chase ended in 1926. In that year, G. K. Noble of the American Museum of Natural History and Hans Przibram, director of the institute where Kammerer worked, examined the famous specimens. They reported their sensational findings in adjacent papers in *Nature* [**118**, 209 (1926)]. The acquired characters, which Kammerer claimed to have made hereditary, turned out to be India ink.

Kammerer admitted the fraud in a letter to the Presidium of the Communist Academy of Moscow—the letter in which he announced his impending suicide—but he claimed to have been personally innocent of deception and ignorant of the identity of the person who was responsible for the chicanery (*5*).

Western biologists as a whole have tended to excuse Kammerer and blame the fakery on some overzealous assistant. Such "assistance" was actually given the great Russian physiologist, I. P. Pavlov. At the International Congress of Physiology held in Edinburgh in 1923, Pavlov announced that he had proved that the conditioning of reflexes was inherited (*6*). This turned out to be false, and Pavlov retracted the statement (*7*). Further details were given by B. G. Gruenberg (*8*).

Although it is remotely possible that Kammerer, like Pavlov, was fooled by an assistant, the probabilities are against such an interpretation. For 7 years Kammerer skillfully evaded his critics' demands to allow them to examine his specimens. It was not until 1926 that his specimens were finally investigated and, when examined, were found to be frauds. Apparently Kammerer preferred suicide to repeating his work.

For the last quarter of a century, Kammerer has not been taken seriously in the West. In Russia, however, attempts were made immediately to salvage his reputation (*9*). Serious attempts to spread the rehabilitation of Kammerer from Russia to western Europe, however, appear not to have been made until 1948, when the inheritance of acquired characters became an official Soviet doctrine.

The Lenin Academy of Agriculture met in 1948 from 31 July through 7 Aug. (This was the session in which Lysenko triumphed and five geneticists found it

expedient to recant.) The fifth speaker in the second session (2 Aug.) was Academician N. G. Belensky. In his speech he quoted Kammerer's work on salamanders as proof of the inheritance of acquired characters. His speech was included in the official proceedings, which were translated and printed in English (*10*). In the English version, Belensky devoted two pages to listing and endorsing Kammerer's data and wrote nothing whatever about its admitted fraudulence. This, of course, did no harm in itself, for the biologists of the world have been alerted to the standards of Lysenko's followers.

Two years later, however, Kammerer's data were being cited in Britain by Alan G. Morton (*11*).

> The classical experiments of Kammerer are certainly very striking, and it is unfortunate that they should have been surrounded by so much irrelevant prejudice. It is no argument to say that they have not been confirmed merely because no one else has undertaken the necessary laborious investigation.

In another 2 years Kammerer's claims had become incorporated in the history of science. Philip G. Fothergill (*12*) devoted two pages to a description of Kammerer's data on salamanders, and nowhere does he mention the fact that Kammerer had written, "Indeed there were still other objects (blackened salamanders) upon which my results had plainly been 'improved' post-mortem with India ink." More recently, Stephen F. Mason (*13*) refers casually to Kammerer, "Kammerer in 1924 observed colour changes in salamanders which he claimed were induced by, and were adaptive to, environmental changes." This statement perhaps could be accepted as sound if it were understood that the environment included India ink and that the adaptiveness meant the ability to be colored. But nowhere does Mason give those details.

Nothing that has been written here should be taken to mean that all those who describe Kammerer's work are knowingly citing fraudulent data. Indeed, there is internal evidence that some are writing in complete innocence, and this fact illustrates the danger in the present situation. A single knowing misrepresentation may start a chain reaction. And not only Kammerer is involved: Academician Belensky (*8*) quoted a great many other data that had been discredited by later and more careful work which he did not mention. The governing board of the American Institute of Biological Sciences even had to protest against the Russian's distortion of the data of Western geneticists (*14*).

The immediate problem raised by the spreading of dishonest data seems to be caused by the existence of an official doctrine. The inheritance of acquired characters is now *de rigueur* in Communist countries. It probably also has a special attraction for other Marxian cults, inasmuch as both Marx and Engels were complete Lamarckians, although they accepted Darwin's natural selection only in part. Whatever the cause, scientists will have to be alerted to the possibility that data now quoted to support the inheritance of acquired characters may do nothing of the sort. It may simply be misinformation disguised as scientific data.

Since the foregoing portion was written, more evidence has been found that shows the existence of a widespread attempt to rehabilitate the doctrine of the inheritance of acquired characters by quoting Kammerer's falsified data. A review of a book by J. Ségal (*15*) indicates that the author followed the Communist Party line in claiming that the Western geneticists had unfairly rejected Kammerer's work without repeating his experiments. The review appeared in a reputable publication (*16*), and the anonymous reviewer—obviously no Communist—furnishes us with another example of the innocent spreading of the misinformation:

> He [J. Ségal] very rightly criticizes geneticists for making no effort to repeat the experiments of Kammerer and others in proof of the inheritance of acquired characters, but makes no mention of the now numerous investigators who have attempted to repeat those of Lysenko and his followers, with negative results. . . .

The attempts to rehabilitate Kammerer in the West present geneticists with an unusual problem. Very rarely in the history of science have efforts been made to propagandize falsehoods knowingly. It should be very interesting to learn how long the attempts will last, how successful they will be, and how many scientists will be deceived.

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